INTERNATIONAL STANDARD

ISO 6

Second edition
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Photography — Black-and-white pictorial still camera negative film/process systems — Determination of ISO speed

Photographie — Systèmes film/traitement négatifs noir et blanc pour photographie picturale — Détermination de la sensibilité ISO

Reference number
ISO 6:1993(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 6 was prepared by Technical Committee ISO/TC 42, *Photography*.

This second edition cancels and replaces the first edition (ISO 6:1974). The primary change is to eliminate the restriction that the ISO speed of all black-and-white films be determined in a specified developer and fixing bath. It also updates references, procedures and the format in accordance with more recent speed standards for other film types.

Annexes A and B of this International Standard are for information only.

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Introduction

Black-and-white films will generally provide excellent results in several different developers and processing conditions. At the same time, it is realized that the speed of a film depends on the process used. Therefore, this International Standard specifies a method for determining the photographic speed of film/process combinations. This means a particular film may have several ISO speeds associated with it depending on the processes used. For this reason, it is important that manufacturers indicate the processing conditions for which ISO speed values are quoted.

This International Standard recognizes that black-and-white films do not generally have a unique speed if several different processes are recommended. This conflicts with the tradition of associating a specific speed value with a particular product. In the future, the process used for determining speed values should be unequivocally described to avoid misinterpretation. Since users often do not know how these films will be processed, manufacturers have an obligation to provide a speed value for this situation which will ensure good results. Usually they will take advantage of the overexposure tonal latitude of the film and give it a conservative speed value to protect users from underexposure effects in case the film is put through a process which yields low speed.

It is recognized that the speed at which a film can be exposed is dependent on the extent of development, scene luminance range, subject matter, printing paper, etc. This International Standard specifies that film/process speed is determined when the film is processed to obtain a specified contrast level. The relative ISO speed ranking of various films in different process systems will generally differ. The ISO speeds will provide correct exposures for average scenes with exposure meters conforming to ISO 2720 or ISO 2721 when the film is processed as specified in this International Standard.

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Photography — Black-and-white pictorial still camera negative film/process systems — Determination of ISO speed

1 Scope

This International Standard specifies the method for determining the ISO speed of black-and-white negative camera films used for pictorial still photography.

This International Standard applies to films processed in conventional chemicals and equipment, but also to those processed using special procedures such as those involving activators or heat for development.

This International Standard does not apply to motion-picture, aerial photography, graphic arts, radiographic or micrographic applications, nor to negatives produced in diffusion transfer systems.

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

ISO 5-3:1984, *Photography — Density measurements — Part 3: Spectral conditions.*

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: The time integral of illuminance on the film, measured in lux seconds.

Amounts of exposure are often expressed in logarithmic terms ($\log_{10}H$).

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

4 Sampling and storage

In determining the ISO speed of a product, it is important that the evaluated samples yield the average results obtained by users. This will require evaluating several different batches periodically under the conditions specified in this International Standard. Prior to evaluation, the samples shall be stored according to the manufacturers' 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 the film characteristics are representative of those obtained by a photographer at the time of use.

5 Test method

5.1 Principle

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

5.2 Safelights

To eliminate the possibility of unintentional exposure to radiation affecting the sensitometric results, all films shall be handled in complete darkness during sample preparation and processing.

5.3 Exposure

5.3.1 Conditioning of specimens

During exposure, the specimens shall be kept at a temperature of 23 °C ± 2 °C and a relative humidity of (50 ± 5) %.

5.3.2 Type of sensitometer

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

5.3.3 Radiant energy quality

The appropriate illuminant for the particular film type being exposed shall conform to the specifications given in ISO 7589. ISO speed may be determined using ISO sensitometric daylight, studio tungsten or photoflood illuminants. Since the speed of film/process combinations will depend on the type of illuminant used for determining ISO speed, the illuminant should be specified in use instructions.

5.3.4 Filters

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

5.3.5 Modulation

The total range of spectral diffuse transmission density 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 a value of 0,03, whichever is greater. In the interval from 360 nm to 400 nm, 10 % of this same average density, or a value of 0,06, whichever is greater, shall not be exceeded.

If stepped increments are used, the base 10 logarithm of the exposure increment shall not be greater than 0,20. 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 continuous variable modulator is used, the base 10 logarithm of the change in exposure with distance along the test strip shall be uniform and not be greater than 0,04 per millimetre.

5.3.6 Exposure time

The exposure time shall be between 5 s and 1/1 000 s corresponding to the usage practice for the particular film tested. Since the speed of film is dependent on exposure time because of reciprocity law failure, the exposure time used for determining ISO speed should be specified in use instructions.

5.4 Processing

5.4.1 Conditioning of specimens

In the time interval between exposure and processing, the specimens shall be kept at 23 °C ± 2 °C and at a relative humidity of (50 ± 5) %. The processing shall be completed in not less than 5 days and not more than 10 days after exposure for general-purpose films, and not less than 4 hours and not more than 7 days after exposure for professional films.

5.4.2 Processing specifications

The only processing specification required in this International Standard is that the density difference between points m and n shall be 0,80 (see 5.6.3 and figure 1). No additional processing specifications are included in recognition of the wide range of chemicals and equipment used in processing black-and-white films. ISO speeds provided by film manufacturers generally apply to films when they are processed in accordance with their recommendations to produce the photographic characteristics specified for the process.

Process information shall be available from film manufacturers or others who quote ISO speed. This shall specify the chemicals, time, 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 film can be achieved by varying the process, other sensitometric and physical changes can also accompany the speed changes. Generally, processes which yield higher ISO speed will also increase the graininess of the negative and the final print.

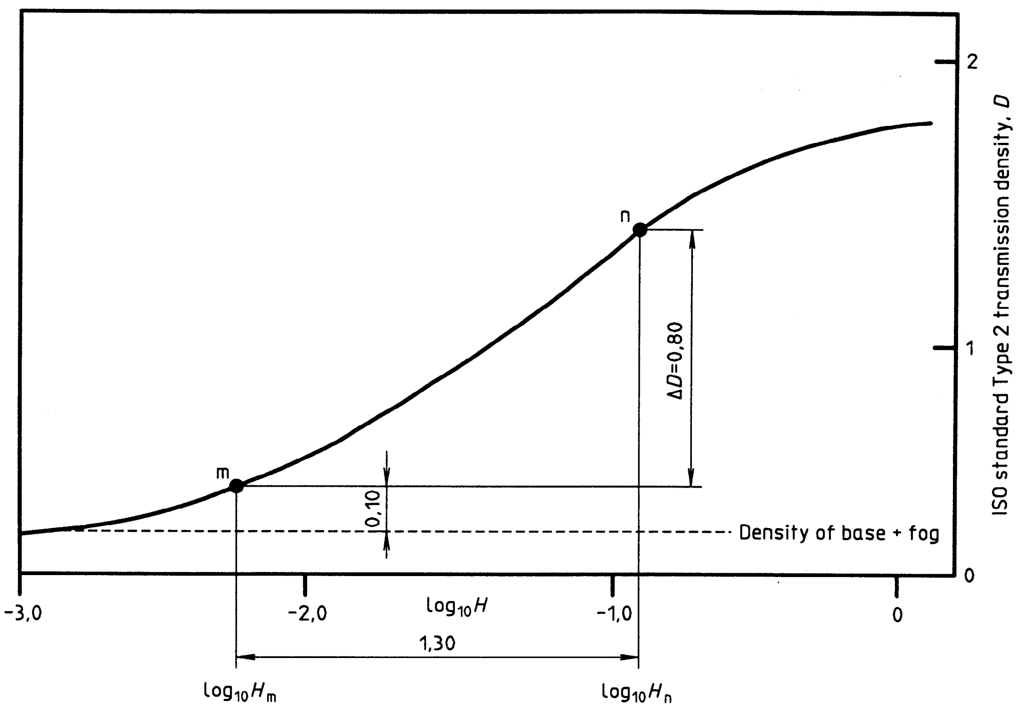

Figure 1 — Method for determining speed

5.5 Densitometry

ISO standard Type 2 diffuse transmission density of the processed images shall be measured using a densitometer complying with the geometric conditions specified in ISO 5-2 and spectral conditions specified in ISO 5-3. Readings shall be made in a uniform area of the image.

5.6 Evaluation

5.6.1 Sensitometric curve

The ISO standard Type 2 diffuse transmission density values are plotted against the base 10 logarithm of the corresponding exposure, H, expressed in lux seconds, to obtain a sensitometric curve similar to that illustrated in figure 1.

5.6.2 Base-plus-fog density

The combination of base and fog density shall be determined from an unexposed sample of the same film processed simultaneously with the film exposed for determining the sensitometric curve.

5.6.3 Determination of H_m

The method for determining speed is illustrated in figure 1. Point m is located on the curve at a density of 0,10 above base plus fog density. Point n is located on the curve where the base 10 logarithm of the exposure is 1,30 units greater than that at point m. The development time of the negative material is so chosen that the density difference, ΔD, between points m and n is 0,80 (see annex A). Then, H_m represents the exposure, in lux seconds, corresponding to point m when the above condition is satisfied.

6 Product classification

6.1 ISO speed scale

The arithmetic speeds, S, and the logarithmic speeds, $S°$, given in table 1 are derived from the following equations

$$S = \frac{0,80}{H_m}$$

$$S° = 1 + 10 \log_{10} \frac{0,80}{H_m}$$

ISO speed shall be obtained directly from $\log_{10} H_m$ by use of table 1 which shows the rounded values of S and $S°$ to be used.

6.2 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 values of $\log_{10} H_m$, determined from various batches of the product when selected, stored and tested as specified above. The ISO speed

of a product with proper rounding is then determined from the mean value of $\log_{10} H_m$ using table 1.

Table 1 — ISO speed scales

$\log_{10} H_m$		ISO speed	
from	to	S	$S°$
−3,65	−3,56	3 200	36°
−3,55	−3,46	2 500	35°
−3,45	−3,36	2 000	34°
−3,35	−3,26	1 600	33°
−3,25	−3,16	1 250	32°
−3,15	−3,06	1 000	31°
−3,05	−2,96	800	30°
−2,95	−2,86	640	29°
−2,85	−2,76	500	28°
−2,75	−2,66	400	27°
−2,65	−2,56	320	26°
−2,55	−2,46	250	25°
−2,45	−2,36	200	24°
−2,35	−2,26	160	23°
−2,25	−2,16	125	22°
−2,15	−2,06	100	21°
−2,05	−1,96	80	20°
−1,95	−1,86	64	19°
−1,85	−1,76	50	18°
−1,75	−1,66	40	17°
−1,65	−1,56	32	16°
−1,55	−1,46	25	15°
−1,45	−1,36	20	14°
−1,35	−1,26	16	13°
−1,25	−1,16	12	12°

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

6.3 Accuracy

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

7 Product marking and labelling

Speed of a product, determined in accordance with this International Standard and expressed on the scales of table 1, may be designated ISO speed and denoted in one of the following forms:

a) by its arithmetic speed , e.g. ISO 100;

b) by its logarithmic speed, e.g. ISO 21°;

c) by both its arithmetic and its logarithmic speed, e.g. ISO 100/21°.

However, since the speed is dependent on the illuminant, exposure time and process used, these conditions should be clearly indicated whenever practical when quoting values to avoid misinterpretation.

Annex A
(informative)

Suggested method of determining $\log_{10} H_m$

The value of $\log_{10} H_m$ can be determined by plotting $\log_{10} H$, at a point where the density is 0,10 above base plus fog density, against ΔD, the difference in density between this point and a point where the base 10 logarithm of the exposure is 1,30 units greater. This is then repeated for a development series.

Draw a smooth curve through the points. Determine the $\log_{10} H$ corresponding to $\Delta D = 0{,}80$ which is designated $\log_{10} H_m$.

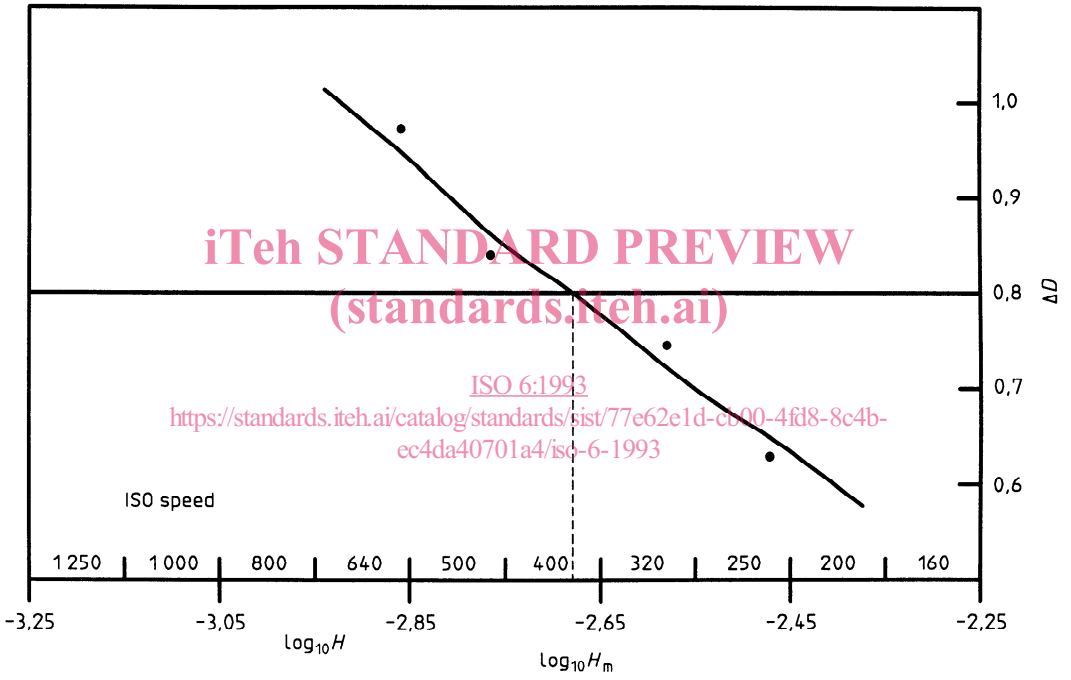

Figure A.1 — Method of determining $\log_{10} H_m$