
INTERNATIONAL STANDARD



2240

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Photography — Determination of ISO speed of colour reversal films for still photography — Sensitometric exposure and evaluation method

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up 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.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2240 was drawn up by Technical Committee ISO/TC 42, *Photography*.

It was approved in September 1971 by the Member Bodies of the following countries :

Belgium	Japan	Thailand
Czechoslovakia	New Zealand	United Kingdom
Egypt, Arab Rep. of	Romania	U.S.A.
France	South Africa, Rep. of	U.S.S.R.
Germany	Spain	
Italy	Switzerland	

No Member Body expressed disapproval of the document.

Photography – Determination of ISO speed of colour reversal films for still photography – Sensitometric exposure and evaluation method

0 INTRODUCTION

The speed equation stipulated in this International Standard is $\text{ISO Speed} = \frac{10}{H_m}$ rather than $\text{ISO Speed} = \frac{8}{H_m}$ which has been used in the past in some national standards. The ratio $\frac{10}{H_m}$ has been specified because it gives ISO Speed values which are in better agreement with speeds determined from picture tests on a variety of products currently in use. It is not expected that the adoption of this equation will result in a change in the speed levels of products currently being manufactured.

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the method of exposure and evaluation for determining the ISO Speed of colour reversal films for still photography that are intended to be viewed on a transparency illuminator or viewed by projection as slides.

2 REFERENCES

ISO/R 5, *Diffuse transmission density (photography)*.

ISO 2239, *Photography – Light sources for use in sensitometric exposure – Simulation of the spectral distribution of daylight*.

ISO 2241, *Photography – Light sources for use in sensitometric exposure – Simulation of the spectral distribution of tungsten illumination*.

ISO 2242, *Photography – Light sources for use in sensitometric exposure – Simulation of the spectral distribution of photoflood illumination*.

3 DEFINITIONS

3.1 speed (as used in this International Standard): A quantitative measure of the response of the photographic material to radiant energy for the specified conditions of exposure, and evaluation with processing in the conventional manner.

3.2 ISO Speed: Speed determined by the method described in this International Standard and expressed on the scales of Table 2. For convenience, ISO Speed may be identified by an abbreviated designation of the general form, "ISO 100" or "ISO 21°", according to whether the arithmetic or logarithmic scale is used.

4 SENSITOMETRIC DERIVATION OF SPEED

The method for determining speed is illustrated by the Figure, in which the curve of density against the logarithm of exposure (H) of a colour reversal film is plotted for the test conditions specified in 5.3. Point T is located on the curve at a density of 0,20 above the minimum density. From point T, a straight line is drawn tangential to the curve at point S. If the tangent point occurs at a density greater than 2,0 above the minimum density, the point S is taken on the curve where the density is 2,0 above the minimum density. The exposures H_t and H_s , corresponding to points T and S, are used as follows to compute the exposure H_m , which represents the sensitometric parameter from which speed is computed:

$$H_m = \sqrt{H_s \times H_t} \quad \text{or} \quad \log H_m = \frac{\log H_s + \log H_t}{2}$$

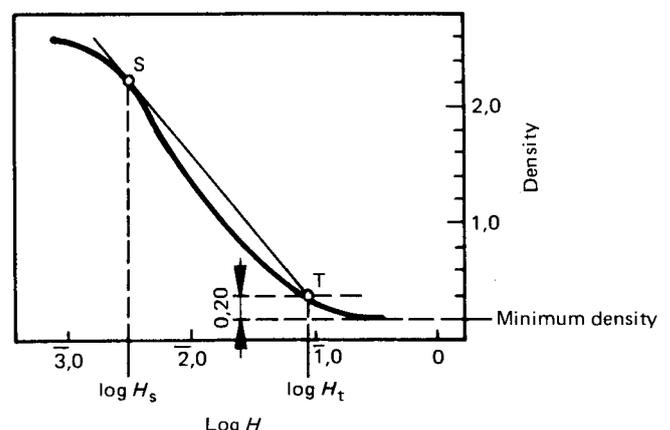


FIGURE – Curve of density against log H

5 DETERMINATION OF THE ISO SPEED OF A SPECIFIC SAMPLE

5.1 Determination of speed

Speed shall be computed by use of the formula :

$$S = \frac{10}{H_m} \quad \text{or} \quad S^\circ = 1 + 10 \log_{10} \frac{10}{H_m}$$

where S or S° is the speed and H_m is the exposure (expressed in lux seconds) determined in accordance with the procedure described in section 4.

5.2 Speed scale

Speed shall be calculated as described in 5.1 but shall be rounded to the nearest step of the scale, as shown in Table 2.

5.3 Testing technique

5.3.1 Conditioning of samples for testing

The test sample shall be in equilibrium with an atmosphere maintained at a temperature of $20 \pm 5^\circ\text{C}$ and a relative humidity of $60 \pm 10\%$.

5.3.2 Exposure

5.3.2.1 Type of sensitometer

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

5.3.2.2 Exposure time

Exposure time shall be between 5 s and 1/100 s, corresponding with the mode for the particular film being tested. Current typical practice for several classes of products is listed in Table 1.

TABLE 1 – Typical exposure times

Film balance	Exposure time (seconds)	
	Roll film	Sheet film
Daylight	1/20 to 1/80	1/20 to 1/80
3 400 K	1/5 to 1/25	1 to 5
3 200 K	1/5 to 1/25	1 to 5

5.3.2.3 Illuminance

The illuminance at the exposure plane of the sensitometer shall be such that, at the exposure time selected, the maximum exposure is no less than that required to produce the minimum density of the reversal image.

5.3.2.4 Modulation

The effective spectral transmission density with respect to the film plane of each area of the light modulator shall not vary more than 5 % throughout the wavelength range from 360 to 700 nm except in the interval from 360 to 400 nm, where 10 % is acceptable.

The change in exposure with distance along the test strip for either continuous or stepped exposures shall not be greater than a factor of 2,5 per centimetre.

If stepped increments are used, the exposure increment shall not be greater than a factor of $\sqrt[3]{4}$ per step.

5.3.2.5 Light source

The light source for the particular film type being exposed shall conform, as appropriate, to ISO 2239, ISO 2241 or ISO 2242.

5.3.2.6 Filters

Any colour correcting filters normally used with a particular type of film shall be used in making sensitometric exposures.

5.3.3 Processing

5.3.3.1 Conditioning of samples

In the time interval between exposure and processing, the samples shall be kept under conditions that will not significantly affect the latent image. The processing shall be completed in less than 10 days but after a delay of at least 1 day.

5.3.3.2 Processing of samples

The processing shall be carried out in accordance with the film manufacturer's recommendations.

5.3.4 Density

The density used in obtaining the characteristic curve of the film shall be diffuse visual density, Type VI-b, as defined in ISO/R 5.

5.3.5 Accuracy

The absolute accuracy of the testing procedure (as specified under 5.3) shall be such that the systematic error in the determination of speed does not alter the logarithm to the base 10 of the unrounded speed more than 0,05.

6 DETERMINATION OF THE ISO SPEED OF A PRODUCT

6.1 General

The speed of a product (as distinguished from that of a specific sample) shall be based on the numerical average of the exposure H_m , determined for at least twelve samples of the product, these samples being selected, stored, and

tested as specified in the following clauses. The speed of a product shall be calculated by using the average value of the exposure H_m in the formula given in 5.1. The average value shall then be rounded to the nearest step as shown in Table 2.

6.2 Sampling and processing

Not less than twelve samples shall be used for testing a product. The samples shall be obtained from the plant of the manufacturer, or from an accredited distributor if they cannot be obtained directly from the manufacturer. They shall be grouped in at least four sets of at least three samples each, the sets being taken at intervals of approximately 1 month. Each sample shall represent a different batch of product, if possible. Not less than four

independent processing operations shall be used with at least three film samples in each.

6.3 Storage of samples

All samples which are to be used in making the tests shall be stored in the unopened package at $20 \pm 5^\circ\text{C}$ and a relative humidity of $60 \pm 10\%$ for a period of 3 months after procurement from the manufacturer or distributor.

6.4 Testing

At the end of the storage period specified above, each sample shall be tested and its speed determined according to the method described in section 5. The average value of H_m for all samples tested shall be used to calculate the ISO Speed of the product.

TABLE 2 — ISO Speed scales

$\log_{10} H_m$		ISO Speed	
from	to	arithmetic	logarithmic
7,65-10	7,74-10	2 000	34°
7,75-10	7,84-10	1 600	33°
7,85-10	7,94-10	1 250	32°
7,95-10	8,04-10	1 000	31°
8,05-10	8,14-10	800	30°
8,15-10	8,24-10	630	29°
8,25-10	8,34-10	500	28°
8,35-10	8,44-10	400	27°
8,45-10	8,54-10	320	26°
8,55-10	8,64-10	250	25°
8,65-10	8,74-10	200	24°
8,75-10	8,84-10	160	23°
8,85-10	8,94-10	125	22°
8,95-10	9,04-10	100	21°
9,05-10	9,14-10	80	20°
9,15-10	9,24-10	63	19°
9,25-10	9,34-10	50	18°
9,35-10	9,44-10	40	17°
9,45-10	9,54-10	32	16°
9,55-10	9,64-10	25	15°
9,65-10	9,74-10	20	14°
9,75-10	9,84-10	16	13°
9,85-10	9,94-10	12	12°
9,95-10	10,04-10	10	11°
10,05-10	10,14-10	8	10°
10,15-10	10,24-10	6	9°
10,25-10	10,34-10	5	8°
10,35-10	10,44-10	4	7°

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