INTERNATIONAL STANDARD 5800

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Photography — Determination of ISO speed of colour negative films for still photography

Photographie — Détermination de la sensibilité ISO des films photographiques négatifs couleur

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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 5800 was developed by Technical Committee ISO/TC 42, *Photography*, and was circulated to the member bodies in August 1977.

It has been approved by the member bodies of the following countries :

Australia	Germany, F. R.	Switzerland
Austria	Italy	Turkey
Belgium	Japan	United Kingdom
Canada	Netherlands	U.S.A.
Czechoslovakia	Poland	U.S.S.R.
Egypt, Arab Rep. of	South Africa, Rep. of	Yugoslavia
France	Spain	

No member body expressed disapproval of the document.

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Photography — Determination of ISO speed of colour negative films for still photography

0 INTRODUCTION

Satisfactory prints can generally be obtained from colour negative films over a significant range of exposure provided that suitable adjustments are made in the printing operation. The underexposure latitude is approximately one camera stop when film speed is determined through the use of this International Standard. Overexposure latitude of a colour negative film can be as large as three camera stops. In other words, if a colour negative film has a speed of ISO 100, it may give satisfactory results if it is exposed anywhere from ISO 12 to ISO 200.

Photographers, on the average, tend to underexpose film, particularly in simple type cameras, as a result of their desire to record events under cloudy conditions or in the shade. Some camera-cartridge systems are designed to take advantage of the overexposure latitude of colour negative films to improve results when pictures are taken under these circumstances. This is accomplished by overexposing the film under sunlight conditions to increase the underexposure latitude of the system. For example, a 110- or 126-size cartridge containing film with an ISO speed of 100 may be notched for ISO 64 speed.

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the method for determining the ISO speed of colour negative films for pictorial still photography. It is assumed that the colour negatives obtained with these films will be used to make reflection-type colour prints primarily but may be used also to make colour transparencies. The speeds obtained by application of this International Standard are intended for practical use with exposure meters, exposure computers, and exposure tables.

Although the speed values determined according to this International Standard may be unreliable in predicting optimum exposure for a specific film when used for aerial photography, they may be useful for comparing two aerial films on a relative basis when used under the same conditions.

2 REFERENCES

ISO 5, *Photography — Determination of diffuse transmission density.*

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 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, processing, and measurement.

3.2 ISO speed : Speed determined by the method specified 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°".

3.3 exposure (H) (as used in this International Standard) : The quantity of radiant energy to which the film is exposed, measured in lux seconds, and designated by the symbol H. Exposure is often expressed in $\log_{10} H$ units.

3.4 camera stop : An historical term indicating an exposure change by a factor of 2 or change of 0,30 in $\log_{10} H$ units. The method of changing exposure is not restricted to aperture. For example, the change could also be accomplished by changing exposure time, illumination level or filters over the lens.

4 SAMPLING AND STORAGE

4.1 Product sampling

In determining the ISO speed of a product, it is important that the samples evaluated are representative of those used by photographers. No fewer than twelve samples shall be obtained from the plant of the manufacturer or from an accredited distributor if they cannot be obtained directly from the manufacturer. In any case, the samples should be

taken from film stored according to manufacturers' recommendations and available in the market. They shall be grouped in at least four sets of at least three samples each, the sets being taken at approximately one-month intervals. Each sample shall represent a different batch of product, if possible. No fewer than four independent processing operations shall be used, with at least three film samples in each.

4.2 Storage of samples

After procurement from the manufacturer or distributor, all samples of a product shall be stored in the unopened package. Storage conditions shall be as recommended by the manufacturer. When no unique recommendation is made, storage shall be at 20 ± 5 °C and a relative humidity of 60 ± 10 %.

4.3 Testing

Each sample shall be tested and its speed determined according to the method set forth in clauses 5, 6, 7, 8 and 9. Note that an unexposed portion of each sample is required for processing under clause 7.

5 SAFELIGHTS

Since films differ in their sensitivity to safelight illumination, all films shall be handled in complete darkness during exposing and processing.

6 EXPOSURE

6.1 Ambient conditions

During the exposure, the samples shall be at a temperature of 20 ± 5 °C and a relative humidity of 60 ± 10 %.

6.2 Type of sensitometer

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

6.3 Exposure time

The exposure time shall be between 5 and 1/1 000 s, corresponding with the usage practice for the particular film being tested. Since the speed of film is dependent on the exposure time because of reciprocity effects, the exposure time should be specified when quoting ISO speed in use instructions.

6.4 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 400 to 700 nm. In the interval from 360 to 400 nm, a variation of 10 % is acceptable.

The change in exposure with distance along the test strip for continuous 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. This is equivalent to a factor of 1,6 or 0,20 $\log_{10} H$ unit. The width and length of a single step shall be at least 4 mm.

6.5 Light source

The light source for the particular film type being exposed shall conform to the latest edition of the appropriate International Standard : ISO 2239, ISO 2241 and ISO 2242.

6.6 Filters

Any colour-correcting filters normally used with a particular type of film may be used in making sensitometric exposures but this does not yield an ISO speed. It does, however, provide an equivalent speed number to determine exposure of the film when specific filters are used. The actual ISO speed of the film shall be determined without a filter in front of the camera lens.

7 PROCESSING

7.1 Conditioning of samples

In the time interval between exposure and processing, the samples shall be kept at 20 ± 5 °C and a relative humidity of 60 ± 10 %. 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 h and not more than 7 days for professional film.

7.2 Processing of samples

The processing shall be carried out in accordance with the film manufacturer's recommendations. An unexposed film sample shall be processed simultaneously with the exposed film to determine minimum density.

8 DENSITOMETRY

Blue, green, and red diffuse integral densities shall be measured using a densitometer whose optics meet the geometric requirements set forth in ISO 5 and utilizing filters which, in conjunction with the instrument lamp, optics, and photocell, yield the logarithmic spectral products aims shown in table 1.[1)]

NOTE – These spectral products aims are reasonable approximations of the spectral sensitivities of colour photographic papers.

1) Table 1 is provided to define Status M densitometry until such time as an International Standard defining spectral conditions for various types of densitometry becomes available.

Since ISO speed is measured at a low density (0,15 above minimum density), departures from true printing densities affect the determinations of ISO speed only slightly.

TABLE 1 — **International standard for Status M relative log spectral products (normalized to 5,00 peak)**
(Includes lamp, optics, filters, and photosensors)

Wavelength nm	Blue	Green	Red
400	*		
410	2,10		
420	4,11		
430	4,63	*	
440	4,87		
450	5,00		
460	4,95		
470	4,74	1,13	
480	4,34	2,19	
490	3,74	3,14	
500	2,99	3,79	*
510	1,85	4,25	
520		4,61	
530		4,85	
540		4,98	
550		4,98	
560	**	4,80	
570		4,44	
580		3,90	
590		3,15	
600		2,22	
610		1,05	
620			2,11
630			4,48
640			5,00
650			4,90
660			4,58
670			4,25
680			3,88
690		**	3,49
700			3,10
710			2,69
720			2,27
730			1,86
740			1,45
750			1,05
			**

* Slope for Status M Red = 0,26/nm
Slope for Status M Green = 0,106/nm
Slope of Status M Blue = 0,25/nm

These slopes are extrapolated data.

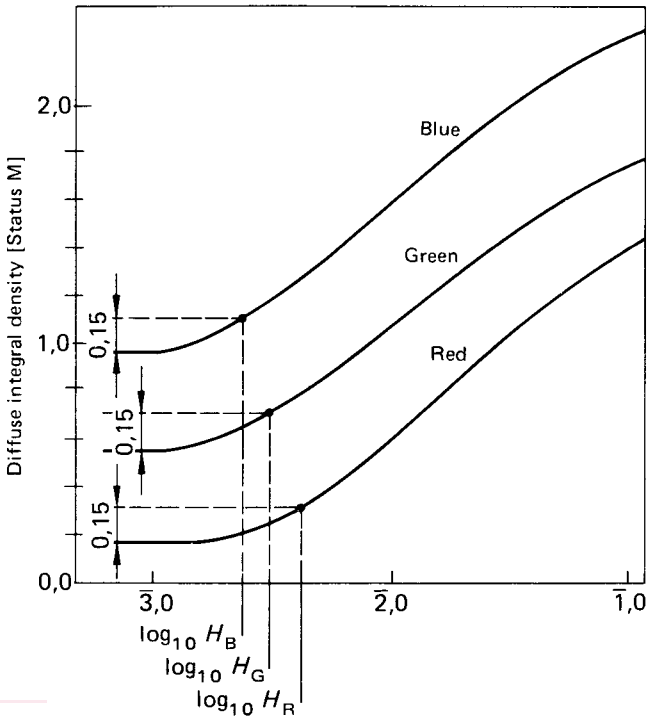
** Slope for Status M Red = − 0,04/nm
Slope for Status M Green = − 0,12/nm
Slope for Status M Blue = − 0,22/nm

These slopes are extrapolated data.

9 EVALUATION

9.1 Sensitometric curve

The blue, green, and red diffuse integral density values determined in clause 8 are plotted against the common logarithm (i.e. logarithm to the base 10) of the exposures (H) expressed in lux seconds as illustrated in the figure.



In the figure above, the Red is the slowest and the formula becomes :

$$\log_{10} H_m = \frac{\log_{10} H_G + \log_{10} H_R}{2}$$

FIGURE — **Method for determining speed**

9.2 Determination of H_m

Speed is calculated from the exposures corresponding to fixed densities of 0,15 above the minimum density for each of the three integral density curves. The exposure, H_m, is computed by use of the formula

$$H_m = \sqrt{H_{Green} \times H_{Slowest\ layer}}$$

or

$$\log_{10} H_m = \frac{\log_{10} H_{Green} + \log_{10} H_{Slowest\ layer}}{2}$$

The exposure, H_m, represents the sensitometric parameter from which speed is computed.

9.3 Calculation of speed

Arithmetic ISO speed shall be computed by use of the formula :

$$S = \frac{\sqrt{2}}{H_m}$$

Logarithmic ISO speed shall be computed by use of the formula :

$$S^\circ = 1 + 10 \log_{10}\left(\frac{\sqrt{2}}{H_m}\right)$$

$$= 1 + 10 \log_{10} S$$

H_m is the exposure (expressed in lux seconds) determined in accordance with the procedure described in 9.1.

9.4 Speed scale

Speed shall be calculated as described in 9.2 but shall be rounded to the nearest step of the scale as shown in table 2. ISO speed can be obtained from $\log_{10} H_m$ by use of table 2.

9.5 ISO speed of a product

The speed of the product (as distinguished from that of a specific sample) shall be based on the numerical average of the common logarithms of exposures, H_m, determined for at least twelve samples of the product when tested as specified above. Table 2 shall then be used to obtain the ISO speed of a product with the proper rounding.

9.6 Accuracy

The absolute accuracy of the test procedure shall be such that the systematic error in the determination of speed does not alter the common logarithm of the unrounded speed by more than 0,05.

TABLE 2 – **ISO speed scales**

$\log_{10} H_m$		ISO speed	
from	to	**Arithmetic**	**Logarithmic**
6,60 – 10	6,69 – 10	3 200	36°
6,70 – 10	6,79 – 10	2 500	35°
6,80 – 10	6,89 – 10	2 000	34°
6,90 – 10	6,99 – 10	1 600	33°
7,00 – 10	7,09 – 10	1 250	32°
7,10 – 10	7,19 – 10	1 000	31°
7,20 – 10	7,29 – 10	800	30°
7,30 – 10	7,39 – 10	640	29°
7,40 – 10	7,49 – 10	500	28°
7,50 – 10	7,59 – 10	400	27°
7,60 – 10	7,69 – 10	320	26°
7,70 – 10	7,79 – 10	250	25°
7,80 – 10	7,89 – 10	200	24°
7,90 – 10	7,99 – 10	160	23°
8,00 – 10	8,09 – 10	125	22°
8,10 – 10	8,19 – 10	100	21°
8,20 – 10	8,29 – 10	80	20°
8,30 – 10	8,39 – 10	64	19°
8,40 – 10	8,49 – 10	50	18°
8,50 – 10	8,59 – 10	40	17°
8,60 – 10	8,69 – 10	32	16°
8,70 – 10	8,79 – 10	25	15°
8,80 – 10	8,89 – 10	20	14°
8,90 – 10	8,99 – 10	16	13°
9,00 – 10	9,09 – 10	12	12°
9,10 – 10	9,19 – 10	10	11°
9,20 – 10	9,29 – 10	8	10°
9,30 – 10	9,39 – 10	6	9°
9,40 – 10	9,49 – 10	5	8°
9,50 – 10	9,59 – 10	4	7°