International Standard ISO 5763

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Photography — Electronic flash equipment — Automatic control of exposure

Photographie — Équipement électronique à éclairs — Contrôle automatique de l'exposition

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Foreword

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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 5763 was developed by Technical Committee ISO/TC 42, *Photography*, and was circulated to the member bodies in December 1980.

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

Australia	Germany, F. R.	Romania
Belgium	Iraq	South Africa, Rep. of
Canada	Italy	Spain
Czechoslovakia	Japan	USA
Egypt, Arab Rep. of	Korea, Dem. P. Rep. of	USSR
France	Mexico	

No member body expressed disapproval of the document.

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Photography — Electronic flash equipment — Automatic control of exposure

0 Introduction

This International Standard gives conditions and measuring values for the calibration of electronic flash equipment with automatic control of exposure.

The calibration values are principally related to the exposure of film in the focal plane. They are equivalent to the exposure in the focal plane of a camera with an automatic exposure control mechanism (see ISO 2721) and are related to an object exposure which is equivalent to that produced when the light output is controlled by the guide number (see ISO 1230).

To establish this correlation it is assumed that most pictures are taken under rather similar conditions.

Deviations from these "average" conditions by special scenes or by special constructions of flash equipment may however, require the consideration of calibration values other than those given in this International Standard.

Certain electronic flash equipment with automatic control of exposure, designed exclusively for a particular camera, may not comply with some of the requirements specified in this International Standard, which are prepared for "general purpose" automatic flash equipment. This is because, in designing "special" flash equipment, all parameters of the particular camera are taken into consideration i.e. camera lens transmittance, vignetting, the relationship between the field of taking lens and the angle of coverage and the acceptance angle of the sensor of the automatic flash equipment, etc., and these parameters will sometimes be different from those of the "average" camera. Tolerances may also be different for the special automatic flash equipment. For example, equipment for instant picture cameras will require a tolerance of $\pm$ 1/3 E_v whereas equipment for the cameras using 110 size colour negative films, according to ISO 5800, the tolerance + 3 E_v or − 1 E_v is acceptable.

Furthermore, even for general purpose automatic flash equipment, deviation from the "average" conditions by special scenes or by special constructions of flash equipment may require the consideration of calibration values other than those given in this International Standard.

Therefore, when testing electronic flash equipment with automatic control of exposure according to the methods specified in this International Standard, the above-mentioned special cases must be taken into consideration. A photographic check of the correct exposure is recommended.

1 Scope and field of application

This International Standard applies exclusively to the automatic exposure control built into or coupled with electronic flash equipment.

It specifies the methods for measuring the characteristics peculiar to the control such as its accuracy and repeatability. It also lays down the numerical values of the integral of time of the object luminance and of the exposure given to an object by flash equipment with automatic exposure control, as well as the maximum deviation from these nominal values. Furthermore, the measuring conditions are stated under which the adjustment of the automatic exposure control is to be tested.

Definitions and measuring methods concerning electronic flash equipment without automatic control of exposure are specified in ISO 2827.

It is assumed that when testing the automatic exposure control, the optical axis of the sensor of the control and of the lamp head of the electronic flash equipment are, when fitted to a camera, substantially coincident with that of the taking lens of the camera.

2 References

ISO 517, *Photography — Still cameras — Lens aperture markings.* [1)]

ISO 1230, *Photography — Determination of flash guide numbers.* [1)]

ISO 2240, *Photography — Colour reversal camera films — Determination of ISO speed.*

ISO 2721, *Photography — Cameras — Automatic controls of exposure.*

1) Under revision.

ISO 2827, *Photography — Determination of light output of electronic flash equipment.*[1)]

ISO 5800, *Photography — Determination of ISO speed of colour negative films for still photography.*

ISO 6728, *Photography — Camera lenses — Determination of colour contribution index.*[2)]

CIE Publication No. 38, *Radiometric and photometric characteristics of materials and their measurement.*

3 Definitions

3.1 automatic exposure control : Exposure control by a photoelectric measuring device which measures the luminance of the object, integrates the light with respect to time, and terminates the exposure when the integral reaches a predetermined value.

3.2 automatic distance range : The range of distance between the object and the flash equipment in which the automatic exposure control can be used in accordance with the indications of the manufacturer. This range depends among others on the guide number of the flash equipment, on the adjustment of the automatic exposure control, and on the luminance coefficient of the object.

3.3 angle of response of sensor for automatic operation : *The angle of response is the half angle from axis of the* reflector of the flash equipment within which the response does not change more than 10 % under the conditions specified in 4.2.2. There are four half angles of response, i.e. on the right, on the left, at the top, and at the bottom of the axis of the reflector.

4 Adjustment of automatic flash-exposure control

4.1 Measurement of the adjustment

4.1.1 Exposure in the focal plane of a camera

The calibration adjustment of the exposure control shall provide, in a camera (with lens transmittance $\tau = 0{,}90$), focal-plane exposure of

$$H_F = \frac{H_c}{S} \quad \text{or} \quad H_F = \frac{H_c}{10^{(S^\circ - 1)/10}} \qquad \ldots (1)$$

where

H_c is a constant, in lux seconds (= 10 lx·s);

S is the ISO speed (arithmetic);

S° is the ISO speed (logarithmic);

the equipment being used with the standard test object.

NOTE — The exposure determined above is expected to be the same as that obtained without automatic exposure control using the manufacturer's assigned guide number Z and with the flash located at a distance $d = Z/A_z$ (expressed in metres), when the standard test object is used. A_z is the f-number of the camera lens.

The measured value of the exposure in the focal plane of a camera (with lens transmittance $\tau = 0{,}90$) shall not differ from the value H_F according to equation (1) by more than the difference which corresponds to 0,5 E_v (1 E_v, exposure value, is equivalent to a factor of 2 change in exposure) i.e. it shall lie between 0,7 H_F and 1,4 H_F (manufacturing tolerance).

4.1.2 Standard test object

The standard test object shall be a nonselective neutral colour, having a diffusely reflecting plane surface. The light reflected from the test object is expressed in terms of its luminance in candelas per square metre per lux of illuminance. The term is named "*luminance coefficient q*", *the standard value being* $q_n = 0{,}08$ cd·m^{-2}·lx^{-1}. This corresponds with a reflectance of about 25 % for a uniform diffuser.

NOTE — In the case of illuminating the object by means of an artificial light source, the exposure H_F in the focal plane of a camera is :

$$H_F = \frac{bq\,\Omega_o}{A^2\,d^2} \int I\,dt \qquad \ldots (2)$$

where

b is a constant, in lux square metres per candela, by means of which mainly the radiation attenuation in a representative lens is considered ($b = 0{,}65$ lx·m^2·cd^{-1});

q is the luminance coefficient of the object, in candelas per square metre per lux;

A is the f-number;

Ω_o is the solid angle = 1 sr;

d is the distance of the light source from the object, in metres;

I is the luminous intensity of the light source, in candelas.

ISO 2721 specifies the mean exposure required by a film with the speed ISO 100/21° to 0,10 lx·s. The defining equation for the guide number (see ISO 1230) establishes a relation between the output or the time integral of the luminous intensity of the artificial light source and the guide number. When inserting the corresponding values in the equation (2), one obtains the luminance coefficient of a mean object, in the case of indoor photography being $q_n = 0{,}08$ cd·m^{-2}·lx^{-1}. This value has been confirmed by measurements on different indoor scenes, where the lighting is generally from the normal to the object.

1) Under revision.

2) At present at the stage of draft.

4.1.3 Distance from flash source to test object

Using the standard test object, and with the equipment preset for film speed ISO 100/21°, the measured distance d_m from the front face of source to test object is :

$$d_m = 2 \text{ m} \quad \ldots (3)$$

Flash equipment of special design that does not include the 2 m distance in its normal automatic distance range may be tested at a different distance as specified by the manufacturer.

If the test object has a luminance coefficient different from q_n, the distance for test can be calculated from equation

$$d_m = 2\left(\frac{q}{q_n}\right)^{1/2} \quad \ldots (4)$$

4.1.4 Conditions for test

Test conditions, in addition to those of 4.1.3, shall be as follows :

a) measurements shall be made under conditions of dark, non-reflective surroundings;

b) the ambient temperature shall be 23 ± 3 °C and relative humidity of 65 ± 20 %;

c) the axis of the reflector shall be within 2° of the optical axis accurately aligned with the normal to the centre of the test object;

d) the test object shall subtend an angle substantially larger than the angle of response of the sensor in or at the automatic flash equipment or the field of the taking lens of the camera used for a test, whichever is larger;

e) the test object should be a uniform diffuser, or at least its diffusing characteristics shall be such that when illuminated from the normal, the luminance when measured from an angle 60° from the normal shall be not less than 50 % of that measured from the normal;

f) the spectral reflectance of the test object shall be uniform within ± 10 % over the wavelength range from 380 to 1 050 nm;

g) the capacitors in the electronic flash unit shall be initially charged for three times the time interval required for the ready light signal to show;

h) immediately prior to measuring the integrated luminous energy, the equipment must be flashed a number of times equal to one-tenth the claimed number of flashes per charge, but not fewer than 5 flashes nor more than 25 flashes. Each flash shall be released at "ready indication". For line powered equipment, the unit shall be operated 25 times;

j) the integrated luminous energy for three successive flashes at 1 min intervals shall be measured. The average of three readings shall be taken.

4.1.5 Measurement of exposure in the focal plane

The exposure in the focal plane of a camera is measured as described in ISO 2721.

The following conditions shall be observed in setting up a standard laboratory camera :

a) the camera shall be located at the measured distance d_m = 2 m and the f-number of the camera lens adjusted for a given film speed as prescribed by the manufacturer of the flash equipment;

b) the camera shall conform to the following requirements :

1) the format shall be 24 mm × 36 mm;

2) operation of the camera shutter shall not prevent the flash light from reaching any part of the focal plane;

3) the focal length of the camera lens shall be about 50 mm and all apertures (f-numbers) shall be calibrated in accordance with ISO 517;

4) camera flare correction factor shall be not greater than 1,03;

5) colour contribution of the lens shall conform to ISO 6728. The transmittance at 360 nm shall be less than 0,10;

6) total visual transmittance of the lens shall be about 0,90;

7) the lens shall be focused at the test object distance;

8) the vignetting factor shall be 1,0;

9) the flash unit axis should be substantially coincident with the lens axis;

10) the value of the constant b of the test camera shall be equal to 0,65 $lx \cdot m^2 \cdot cd^{-1}$.

4.1.6 Measurement of the time integral of object luminance

Another method of evaluating the luminous output of the electronic flash unit is to measure the luminance of the test object during the flash. This measurement is made with an integrating luminance meter. The instantaneous values of test object luminance L_o for corresponding instantaneous values of focal-plane illuminance E_F are given by the equation

$$E_F = \frac{bL_o}{A^2} \quad \ldots (5)$$

The corresponding value is :

$$H_F = \frac{b}{A^2}\int L_o dt \quad \ldots (6)$$

from which the integral of the test object luminance is :

$$\int L_o dt = \frac{A^2 H_F}{b} \qquad \ldots(7)$$

where

L_o is the luminance of test object, measured in candelas per square metre;

A is the f-number of camera lens;

t is the time in seconds;

b is a constant, in lux square metres per candela (= 0,65 $lx \cdot m^2 \cdot cd^{-1}$);

H_F is the measured focal-plane exposure, in lux seconds (for film speed ISO 100/21°); [the value of H_F can be calculated from the measurement and from the equation (6)].

4.1.7 Measurement of the object exposure

The third method of measuring the light output of the electronic flash unit is to measure the exposure H_o of the test object. Knowing the luminance coefficient of the test object, q, the required exposure of the test object can be calculated from equation (9).

$$E_o \overset{\text{def}}{=} \frac{L_o}{q} \quad \text{and} \quad H_o \overset{\text{def}}{=} \int E_o dt = \int \frac{L_o}{q} dt \qquad \ldots(8)$$

By use of equation (6)

$$H_o = \int E_o dt = \frac{A^2 H_F}{qb} \qquad \ldots(9)$$

The value of H_o can be measured with an integrating light-meter and the focal-plane exposure calculated from equation (9).

4.1.8 Repeatability of automatic exposure control

The repeatability of the exposure, measured by any of the three methods, for successive flashes of the same flash unit shall be within ± 0,25 E_v.

Test method

To determine repeatability of the light output 10 flashes are evaluated, the flash being fired under conditions as in 4.1.2, 4.1.3 and 4.1.4 at not less then 30 s after ready light indication. The light may be evaluated by any of the three methods described above, the method given in 4.1.7 is however recognized as being the most simple.

4.2 Influence of exterior measuring conditions on the adjustment of the automatic exposure control

Exterior measuring conditions are the distance between object and flash equipment, the luminance coefficient of the object, the spatial distribution of surfaces with differing spectral reflectance factors in the object plane.

4.2.1 Variation of exposure within automatic distance range

Variation of the measured value as in 4.1, at a distance within the claimed automatic distance range for the indicated f-number shall not vary more than ± 0,5 E_v from the measured value determined in 4.1.1.

4.2.2 Measurement of the angle of response

The flash equipment is set up facing the standard test object. In front of this non-selective neutral diffusely reflecting standard test object, a similar object with a luminance coefficient greater by factor 2 and a straight edge line, is slid from the edge toward the centre of the first object, until the automatically controlled flash exposure on the total object has decreased by 10 % compared to the exposure on the first object.

The angle between the axis of the reflector of the flash equipment and the edge of the second object is called angle of response.

NOTE — If the angles of response are determined by means of the exposure in the focal plane or the integral of time of the luminance, one must avoid the fact that the second, lighter object enters the field of view of the measuring instrument. The distance from flash equipment to test object should be d_m = 2 m according to equation (3).

5 Recycle time

The electronic flash equipment is prepared and the recycle time measured as described in ISO 2827.

For flash equipment which switches off the flash tube, three recycle times are indicated : one with the automatic exposure control switched off and two with the automatic exposure control switched on. For the evaluation of the recycle times, when the automatic exposure control is switched on, the equipment is set at the distance d_m = 2 m and at that distance before the object which is indicated as the minimum distance by the manufacturer.

NOTE — As the period between the release of the flash and the following indication of readiness for flash release may be very short, an automatic release of the flashes and a photoelectric time measurement is recommended.

6 Number of flashes per battery or per charge

The equipment shall be in the condition and the number of flashes shall be measured as specified in ISO 2827.

On equipment capable of changing the energy per flash by exposure control systems, the operating conditions of the equipment must be fully specified and the number of flashes, besides those specified in ISO 2827, given for :

a) automatic mode at specified distance d_m = 2 m and at a luminance coefficient of q = 0,08 $cd \cdot m^{-2} \cdot lx^{-1}$ and a specified exposure range (f-number and film speed setting);

b) automatic mode at closest working distance and at a subject of a luminance coefficient of q = 0,08 $cd \cdot m^{-2} \cdot lx^{-1}$ and a specified exposure range. The distance shall be indicated.

Bibliography

[1] HOESCHEN, D., and VIETH, G., *Measuring methods for the adjustment of the automatic exposure control of electronic flash equipment*. PTB-Mitt. **83**, 1973 : p.232 (in German).