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Photography — Determination of flash guide numbers for electronic flash equipment

Photographie — Détermination des nombres guides des appareils à éclairs

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 1230 was prepared by Technical Committee ISO/TC 42, *Photography*.

This third edition cancels and replaces the second edition (ISO 1230:1992), which has been technically revised.

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Introduction

In general flash photography, where the flash light source is mounted on a camera, the product of the camera lens f-number and the distance from the flash light source to the subject is a constant with respect to the ISO speed of the film or the digital still camera to be used. The illuminance of the subject varies with the distance according to the inverse-square law and, in order to obtain the same suitable exposure on film or image sensor, the f-number is adjusted with respect to the square root of the illuminance of the subject.

The constant is named “flash guide number” and is a very useful guide for flash photographers, because the guide number represents, in a sense, the power of illumination of the light source, for both flash lamps with and without integral reflectors and electronic flash equipment. The camera lens f-number setting can easily be calculated by dividing the guide number by the distance from the flash light source to the subject.

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Photography — Determination of flash guide numbers for electronic flash equipment

1 Scope

This International Standard specifies the definition and determination of the ISO guide number of electronic flash equipment. It does not specify the definitions and measuring methods for the light output of electronic flash equipment, which are specified in ISO 2827.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
guide number
N_{GN}
product of the camera lens f-number, required for a suitable exposure on a film or an image sensor, and the distance from the flash light source to the subject with respect to the ISO speed of the film or the digital still camera to be used

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NOTE The guide number is expressed in metres. Annex A provides the conversion calculation for converting the guide number from metres into feet.

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2.2
ISO guide number
$N_{ISO/GN}$
guide number, for a film or a digital still camera of ISO 100, "X" synchronization and an exposure time which can fully utilize the total output of the flash light source

3 Calculation of the guide number

3.1 ISO guide number

The ISO guide number, $N_{ISO/GN}$, shall be calculated using the following formula:

$$N_{ISO/GN} = \sqrt{k \int I(t)\,dt} \tag{1}$$

where

k is a constant equal to 0,51 $lm^{-1} \cdot m^2 \cdot s^{-1}$;

$\int I(t)dt$ is the time integral of the luminous intensity of electronic flash equipment, expressed in candella seconds ($cd \cdot s = lm \cdot sr^{-1} \cdot s$).

See Annex B for details of Equation (1).

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3.2 Guide number for any ISO speed other than 100

The guide number for any ISO speed other than 100 can be calculated from the following formula:

$$N_{(\mathrm{ISO},S)} = N_{\mathrm{ISO/GN}} \times \sqrt{\frac{S}{100}} \qquad (2)$$

where S is the ISO speed (arithmetic).

4 Designation of guide number

Designation of guide numbers on products or instructions should be rounded to two significant digits and followed by metres. When a guide number does not express the ISO guide number [i.e. for films or digital still cameras other than those of ISO speed 100 (arithmetic)], the reference ISO speed should follow in parentheses.

EXAMPLES

$N_{\mathrm{ISO/GN}}$ 20 m

N_{GN} 40 m (ISO 400)

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Annex A
(informative)

Conversion calculation of the ISO guide number from metres into feet

A.1 Conversion factor

ISO guide numbers, expressed in feet, can be obtained from the metre guide numbers by multiplying by the factor 3,28.

A.2 Designation of guide number in feet

Designation of guide numbers on products or instructions should be rounded to the two significant digits and followed by feet. When a guide number does not express the ISO guide number [for films or digital still cameras other than ISO speed 100 (arithmetic)], the reference ISO speed should follow in parentheses.

EXAMPLES

$N_{ISO/GN}$	20 m
$N_{ISO/GN}$	66 ft
N_{GN}	40 m (ISO 400)
N_{GN}	130 ft (ISO 400)

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Annex B
(informative)

Explanation of guide number formula

B.1 Derivation of the numerical value

The numerical value for $k = 0{,}51$ in Equation (1) was determined by combining all numerical values and constants in the guide number formula of ISO 1230:1973 as follows:

$$N_{GN} = 0{,}3\sqrt{4\pi\ C \times It \times S_x} \tag{B.1}$$

where

N_{GN} is the guide number, expressed in metres (m);

0,3 is the metre-foot conversion factor ($m \cdot ft^{-1}$);

C is a constant and its numerical value is 0,004 5 ($lm \cdot m^{-2} \cdot s^{-1}$);

It is the effective luminous intensity, I, of the electronic flash equipment, expressed in candelas, multiplied by the effective exposure, t, expressed in seconds (cd·s);

S_x is the arithmetic ISO film speed of x, and in this case, x is equal to 100.

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If It is substituted by $\int I(t)\mathrm{d}t$, Equation (B.1) is equivalent to Equation (1) in 3.1.

B.2 Derivation of ISO guide number formula

This International Standard was based on the old ANSI PH2.4-1965 (which is now ANSI/NAPM IT2.24-1996) and the procedure for the derivation of the guide number formula is as follows:

The initial equation is based on the calibration equation for incident-light type exposure meters in ANSI PH2.12-1961 as follows:

$$t = \frac{C' \times A^2}{E \times S} \tag{B.2}$$

where

E is the illuminance at the object plane, expressed in footcandles (fc);

t is the exposure time, expressed in seconds (s);

A is the f-number;

S is the ASA (arithmetic ISO) film speed;

C' is a constant and its numerical value equal to 20,8 fc·s [to distinguish the constant C used in the old ANSI PH2.4-1965, with the constant C in the guide number equation given in Equation (B.1), C' is used here].

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According to ANSI PH2.12-1961, the numerical value of K for reflected-light type exposure meters is equal to 1,06 (cd·ft^{-2}·s). From the numerical values of K and C', the diffuse reflectance of the object, which is assumed to be an isotropic diffuser (formerly called a uniform diffuser), can be calculated by the following equation:

$$\frac{1{,}06\pi}{20{,}8} = 0{,}160 \quad (= 16\ \%) \tag{B.3}$$

The equation for the illuminance with an accessory reflector is:

$$E = \frac{\Phi \times M}{4\pi \times d^2} \tag{B.4}$$

where

Φ is the luminous flux, expressed in lumens (lm);

M is the reflector factor;

d is the distance, expressed in feet (ft), between a lamp and a subject.

Combining Equations (B.2) and (B.4) gives:

$$t = \frac{4\pi \times A^2 \times d^2 \times C'}{\Phi \times M \times S} \tag{B.5}$$

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Rearranging Equation (B.5) gives:

$$A^2 \times d^2 = \frac{\Phi \times t \times M \times S}{4\pi \times C'} \tag{B.6}$$

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$$A \times d = N_{GN} = \sqrt{\frac{\Phi \times t \times M \times S}{4\pi \times C'}} \tag{B.7}$$

By substituting the numerical value of π (3,14) and C'(20,8), Equation (B.7) becomes:

$$N_{GN(ft)} = \sqrt{0{,}003\,8\,\Phi \times t \times M \times S} \tag{B.8}$$

ANSI then rounded 0,003 8 (fc^{-1}·s^{-1}) to 0,004, which is the numerical value of C in the guide number formula, and corresponds with a reflectance of 16,7%.

In the case of electronic flash equipment, the guide number formula is calculated by Equation (B.9) if the relationship [$I = \Phi \cdot M/4\pi$] is taken into consideration:

$$N_{GN(ft)} = \sqrt{0{,}004 \times 4\pi \times It \times S} \tag{B.9}$$

In Equation (B.9), 0,004 is the rounded value of 0,003 8.

Since 1 ft = 0,30 m (i.e. 0,304 8 m to be exact), the metre-guide number formula becomes:

$$N_{GN} = 0{,}3\sqrt{0{,}004 \times 4\pi \times It \times S} \tag{B.10}$$

Despite the fact that the calculated value of C is 0,004, the value of 0,004 5 was adopted by TC 42 in the first edition of this International Standard (ISO 1230:1973) [see Equation (B.1)] to factor in the discrepancy between the numerical value of the guide number obtained according to the old ANSI PH2.4-1965 and that obtained according to the former German standard DIN 19011 (all parts) [13] [14] [15] (June 1969 or January 1971 version).

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