# INTERNATIONAL STANDARD ISO 2827

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

# Photography — Determination of the light output of electronic flash equipment

First edition — 1973-11-01



UDC 771.448.6 Ref. No. ISO 2827-1973 (E)

**Descriptors :** photography, photographic equipment, flash lamps, electronic flash tubes, tests, light output.



Price based on 3 pages

## 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 2827 was drawn up by Technical Committee ISO/TC 42, *Photography*, and circulated to the Member Bodies in July 1972.



It has been approved by the Member Bodies of the following countries :

| | | |
|---|---|---|
| Australia | Germany | Switzerland |
| Belgium | Japan | Thailand |
| Canada | Mexico | United Kingdom |
| Czechoslovakia | Netherlands | U.S.A. |
| Egypt, Arab Rep. of | Romania | U.S.S.R. |
| France | South Africa, Rep. of | |



The Member Body of the following country expressed disapproval of the document on technical grounds :

Italy

# Photography — Determination of the light output of electronic flash equipment

## 1 SCOPE AND FIELD OF APPLICATION

This International Standard defines terms and specifies methods of measurement, in reference to electronic flash equipment of the single flash type which is primarily intended to provide illumination for photography with cameras in which the contacts that control the flash are closed when the shutter of the camera is fully or nearly fully open.

## 2 REFERENCE

ISO 1230, *Photography — Determination of flash guide numbers.*



## 3 DEFINITIONS

**3.1 electronic flash equipment :** An electronic flash tube, usually mounted in a suitable reflector, and the appropriate apparatus for activating the flash tube.

**3.2 electronic flash tube :** A light-transmitting envelope containing a gas through which the energy from a storage capacitor is discharged, thereby producing a flash of light, the spectral distribution of energy of which depends on the gas filling and the design factors

**3.3 luminous flux, $\Phi(t)$ :** Quantity derived from radiant flux by evaluating the radiation according to its action upon a selective receptor, the spectral sensitivity of which is defined by the standard spectral luminous efficiencies.

**3.4 quantity of light, $Q = \int \Phi(t)\mathrm{d}t$ :** Product of luminous flux and its duration.

**3.5 coverage of light :** The spread of the light emitted, characterized by the included solid angle of the beam of light produced within defined limits of the quantity of light and orientation.

**3.6 flash duration :** The time interval from the instant the flash first reaches one-half of its peak intensity to the instant it decays to the same value.

**3.7 recycle time :** The time required, under the stipulated test conditions, for the voltage at the energy storage capacitors to reach 85 % of the peak voltage.

**3.8 candela second :** The unit of the time-integral of the intensity of the beam of light in candlepower ($\int I(t)\mathrm{d}t$).

**3.9 peak voltage :** The maximum voltage at the energy storage capacitors of flash equipment as measured with a high impedance voltmeter, for example not less than 20 kΩ/V, during a charging cycle, when the increase in voltage during a 10 s interval is less than 1 %.

**3.10 energy $E_n$ :** The energy stored in the capacitors expressed in joules (watt-seconds) and determined by the formula,

$$E_n = \frac{CU^2}{2}$$

where $C$ is the capacitance of the combined energy-storage capacitors in microfarads and $U$ is the peak voltage in kilovolts.

**3.11 spatial distribution of light exposure, $\int E(t)\mathrm{d}t$ :** The distribution of light exposure over a surface perpendicular to the axis of the reflector.

**3.12 half angle of coverage :** The angle between the axis of a beam of light and the line to the point where the light intensity falls to one-half of the maximum in the beam. This value may differ in various directions (for example, rectangular beams). In cases where equipment is designed to illuminate a square or rectangular format, the angle of coverage is taken as the angle from the diagonal.

**3.13 reflector factor :** The amplification of the luminous intensity taking the beam intensity in a solid angle 2 × 5° around the axis of the reflector, compared to that from a bare flash tube in a direction perpendicular to the axis of the flash tube.

**3.14 effective reflector factor :** The mean value of the reflector factors determined at four given angles (see 6.4).

## 4 TEST CONDITIONS AND PROCEDURES

### 4.1 Test conditions

The energy stored in the capacitor depends on its capacitance and the peak voltage to which it is charged. The proportion of the capacitor-stored energy that is delivered to the tube is dependent on the total circuit impedance which includes the internal resistance of the capacitor and the impedance of the connecting leads, etc. Wherever possible, the light output of the tube or equipment shall be measured using the power supply and connecting leads with which it is intended to be used. In other cases, the values of the capacitance, voltage and total impedance shall be stated.

### 4.2 Photometric tests

Luminous flux measurements of tubes without reflectors shall be made in an integrating sphere equipped with a photocell-filter combination. By connecting the photocell to a suitable oscilloscope, the luminous flux versus time curve can be recorded and/or, by connecting the photocell to an electronic integrator, the total quantity of light may be measured.

### 4.3 Test apparatus

The apparatus shall comprise :

a) an integrating sphere of the type generally used for the measurement of the lumen output of light sources;

b) a vacuum photocell and filter combination having a spectral response approximating to the luminosity curve of the CIE standard photometric observer;

c) a cathode ray oscilloscope with a high frequency response in the "Y" axis and a uniform single sweep speed in the "X" axis. The single sweep speed shall be adjustable so that the complete sweep over the oscilloscope screen lies in the range of 100 µs to 20 ms. The beam intensity shall be modulated in the range of 500 Hz to 50 kHz for time markers. A cathode follower circuit shall be used to avoid loss of frequency response due to the capacitance of the cable connecting the photocell to the oscilloscope. A relay or electronic circuit shall be used to initiate the single sweep circuit of the oscilloscope just before the flash tube is triggered;

d) an electronic integrator capable of integrating the photocurrents obtained;

e) a photometer bench on which the tube with reflector and the photocell-filter combination may be mounted for measurements of luminous intensity. Suitable baffles, diaphragms, etc., shall be used to ensure the light reaches the photocell unit only by direct path and not by reflections from other objects. The effective sensitivity of the photocell shall be controlled by placing in front of it a suitably sized aperture covered by a diffuser.

## 5 CALIBRATION

### 5.1 Calibration of the integrating sphere and photometer bench

Calibration of the apparatus used for the luminous flux measurement is made by substituting a tungsten lamp of known lumen output for the flash tube in the integrating sphere.

Calibration of the equipment used for luminous intensity measurement is made by substituting a tungsten lamp of known luminous intensity for the tube with reflector on the photometer bench.

In both cases the peak output from the electronic flash equipment is likely to be much greater than the output of the tungsten lamp used for calibration. Compensation for this can be made by altering the sensitivity of the equipment in a known ratio by any of the following means :

a) by using different diaphragms of known areas over the window of the integrating sphere, the light transmission from the integrating sphere to the photocell can be altered in a known ratio;

b) in measuring luminous intensity on a photometer bench, the distance from the source to the photocell may be altered and the ratio of sensitivities calculated by the inverse square law;

c) if the output is being observed on an oscilloscope, the value of the load resistor for the photocell may be changed in a known ratio.



In all measurements, precautions shall be taken to ensure that the peak photocell current is within the limits where the photocurrent is linearly proportional to the light flux incident on the photocell.

### 5.2 Calibration of the electronic integrator

The electronic integrator shall be calibrated using the appropriate calibrated tungsten lamp referred to in 5.1 and a suitable shutter which shall be interposed between the photocell and the lamp[1]. By opening the shutter for a measured interval, the system of integrating sphere and electronic integrator, or photometer bench and electronic integrator, can be calibrated in terms of lumen seconds or candela seconds, respectively.

## 6 METHODS OF MEASUREMENT

### 6.1 Spatial distribution of the light exposure ($\int E(t)dt$)

The measurement of $\int E(t)dt$ shall be made at six angles : 2,5°; 7,5°; 12,5°; 17,5°; 22,5° and 27,5°. The measurements at 22,5° and 27,5° are taken in order to

1) The shutter may be replaced by an electronic system which starts and stops the integration.

ascertain that the beam intensity at 25° is at least 50 % of the maximum beam intensity.

The following procedure is recommended (see figure) : receiver 1 is fixed and serves as a control; receiver 2 is moved to measure the spatial distribution. Both receivers 1 and 2 lie in the same plane of measurement, lying perpendicular to the reflector axis or to the plane of symmetry of the reflector at a distance *a* from the edge of the reflector. This distance *a* shall be at least 20 times the widest aperture of the reflector with a minimum of 3 m.

Connect the receivers to a measuring apparatus in which it is possible to obtain the quantity of illumination at two points of the plane of measurement for one single flash. In order to obtain a complete spatial distribution, rotate the reflector around the symmetry axis.

### 6.2 Spatial distribution of the intensity of the light ($\int I(t)dt$)

Calculate this value, in candela seconds, in the given direction by dividing the $\int E(t)dt$-values (see 6.1) by $\cos^3\alpha$ ($\alpha$ representing the respective angles).

### 6.3 Quantity of light ($\int \Phi(t)dt$)

If the quantity of light emitted by the equipment is required, determine it by plotting values $\int I(t)dt$ (see 6.2) and integrating the area within the curve obtained.

### 6.4 Effective reflector factor

Use the method described in 6.1 to determine the relative values of $\int E(t)dt$ for the combined flash tube/reflector and the bare flash tube.

It is not necessary to use the individual values for $\int I(t)dt$, but when values are measured at 2,5° and 7,5° multiply them by a factor 3; at 12,5° by a factor 2 and at 17,5° by a factor 1; divide the sum of the values found by 9.

### 6.5 Half angle of coverage

Prepare a graph of the values found in 6.1 for the combined flash tube/reflector. From this graph, read the angle at which the illumination is one-half of the maximum value.

### 6.6 Guide numbers

Determine the guide numbers as laid down in ISO 1230.



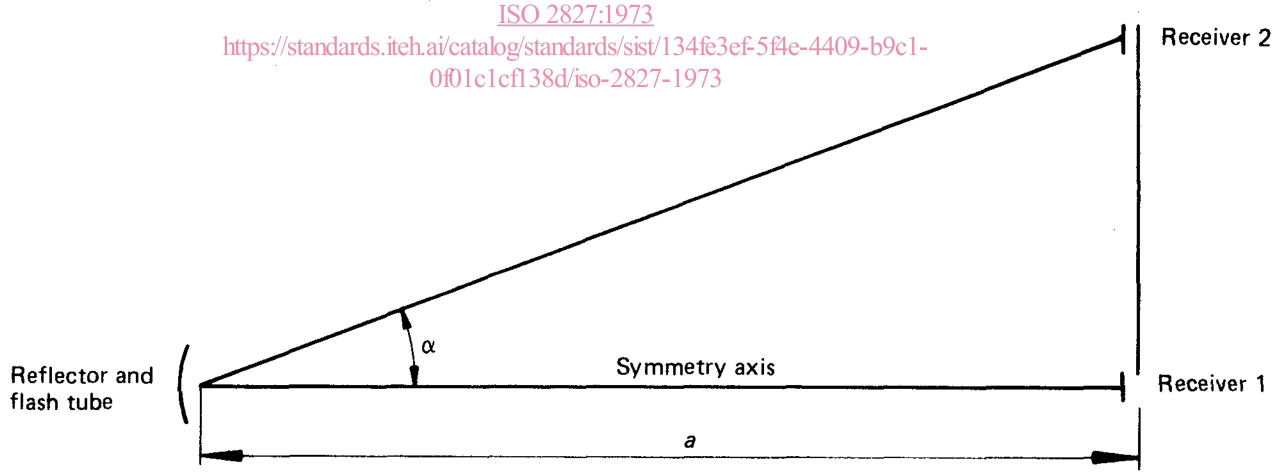


FIGURE – **Measurement of spatial distribution of the light exposure**