IS 15486 (2004): Photography - Camera Lenses - Measurement of ISO Spectral Transmittance [MED 32: Photographic Equipment]

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IS 15486 : 2004
ISO 8478 : 1996

भारतीय मानक

फोटोग्राफी — कैमरे के लैन्स — आई एस ओ स्पेक्ट्रमी संचरण का मापन

Indian Standard

PHOTOGRAPHY — CAMERA LENSES — MEASUREMENT OF ISO SPECTRAL TRANSMITTANCE

ICS 37.040.10

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

July 2004

Price Group 4

Photographic and Cinematographic Equipment Sectional Committee, ME 32

NATIONAL FOREWORD

This Indian Standard which is identical with ISO 8478 : 1996 'Photography — Camera lenses — Measurement of ISO spectral transmittance' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendations of the Photographic and Cinematographic Equipment Sectional Committee and approval of the Mechanical Engineering Division Council.

The text of ISO Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

The concerned Technical Committee has reviewed the provisions of ISO 6728 : 1983 'Photography — Camera lenses — Determination of ISO colour contribution index referred in this standard and has decided that it is acceptable for use in conjunction with this standard.

Annex A forms an integral part of this standard.

Indian Standard

PHOTOGRAPHY — CAMERA LENSES — MEASUREMENT OF ISO SPECTRAL TRANSMITTANCE

1 Scope

This International Standard specifies a method for measuring the spectal transmittance of camera lenses. It describes particular conditions for measuring the axial spectral transmittance, over a wavelength range from 350 nm to 700 nm, of camera lenses which are intended to be used mainly for taking pictures of very distant objects.

If the spectral transmittance values are used exclusively for the calculation of the ISO colour contribution index (see ISO 6728), throughout this International Standard, the wavelength range should read 370 nm to 680 nm.

This International Standard is also applicable to mirror lenses (see annex A).

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 6728:1983, *Photography — Camera lenses — Determination of ISO colour contribution index (ISO/CCI).*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 photographic lens: Lens used for recording the image of an object on photosensitive material, such as a camera or enlarging lens.

NOTE — A projection lens is not a photographic lens.

3.2 camera lens: Lens attached to a still camera used for taking pictures of an object.

3.3 spectral transmittance of a lens: Transmittance denoted by $\tau(\lambda)$ and defined by the equation

$$\tau(\lambda) = \frac{\Phi_{\tau,\lambda}}{\Phi_{i,\lambda}}$$

where

$\Phi_{\tau,\lambda}$ is the transmitted radiant flux of wavelength λ;

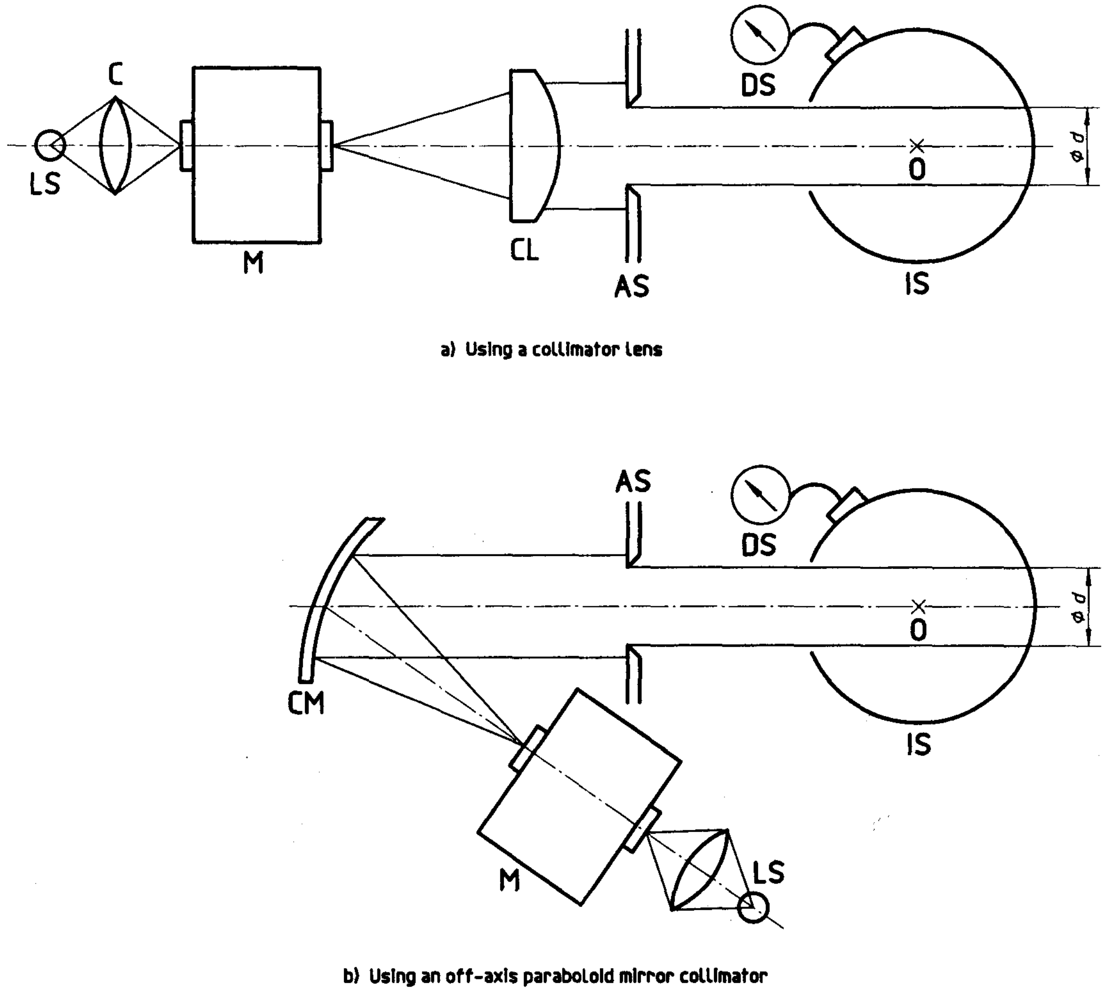
$\Phi_{i,\lambda}$ is the corresponding incident radiant flux of wavelength λ.

4 Apparatus

4.1 General

The apparatus (see figure 1) shall consist of a light source, a condenser lens, a monochromator (or narrow-bandwidth filters, in limited applications), an aperture stop, a collimator and an integrating sphere together with a photoelectric detector system.

NOTE — Narrow-band filters are subject to errors due to inter-reflections with other components. The use of narrow-band filters should be limited to applications where proper corrections can be applied.



Key

LS	Light source	CM	Collimator mirror	O	Centre of integrating sphere
C	Condenser lens	AS	Aperture stop	*d*	Diameter of beam
M	Monochromator	IS	Integrating sphere		
CL	Collimator lens	DS	Detector system		

Figure 1 — Arrangement of the apparatus (test lens not shown)

4.2 Light sources

The light source shall be capable of emitting a spatially and temporally stable radiant flux over the wavelength range of 350 nm to 700 nm. Spatial variations shall not exceed the acceptance angle of the condenser; temporal variation shall be less than 1 %.

4.3 Monochromator

The monochromator shall preferably be a double monochromator which shall employ two prisms or two gratings, or one prism and one grating.

If a grating monochromator is used, it shall employ a filter or filters to cut off the higher-order diffracted radiation. The wavelength range shall be from 350 nm to 700 nm.

Narrow-band filters may be used in place of the monochromator, provided that there are sufficient filters to cover the required wavelength interval, and the filters shall have sufficient blocking outside the pass band. Corrections shall be applied for inter-reflections.

For both the monochromator and the narrow-band filters, the wavelength interval and bandwidth shall be 10 nm or less and adjustable. A 20 nm interval and bandwidth is satisfactory in the spectral region where the transmittance variance is less than 0,2 % per nanometre. For the calculation of the ISO colour contribution index, 10 nm intervals are required.

4.4 Collimator

The collimator shall be either a lens or a mirror. In both cases, its focal length shall be at least 30 times the length of the monochromator exit slit.

If a lens is used, its focal length should not change by more than 1 % for any monochromatic radiation within a wavelength range from 350 nm to 700 nm.

If a mirror is used, it shall preferably be of off-axis paraboloid design.

4.5 Aperture stop

The aperture stop shall be circular in shape and its diameter shall be adjustable.

4.6 Integrating sphere

The radius of the integrating sphere shall be selected such that the location and diameter of the beam on the rear wall of the integrating sphere is the same, with or without the lens in position, to within a tolerance of ± 50 %. The diameter of the entrance port shall be greater than half the diameter of the entrance pupil of the lens to be tested.

The spectral reflectance of the diffusing coating on the internal surface of the integrating sphere shall be as high and non-selective as possible over a wavelength range from 350 nm to 700 nm.

4.7 Detector

The detector shall have sufficient responsivity over a wavelength range from 350 nm to 700 nm. The detector's response, in combination with the electronic circuitry, shall be calibrated over the measuring range. The area of the detector shall be as small as possible and the surface of the detector shall be level with the inside surface of the integrating sphere (e.g. the surface of the detector shall be within ± 1 mm of the inside surface of the sphere). The spectral reflectance of the detector surface shall be as close as possible to that of the internal surface of the integrating sphere.

5 Conditions

5.1 The wavelength range shall be from 350 nm to 700 nm.

5.2 The wavelength interval shall be 10 nm or less. If spectral variation is less than 0,2 % per nanometre, the wavelength interval may be 20 nm, but not for the calculation of the ISO colour contribution index.

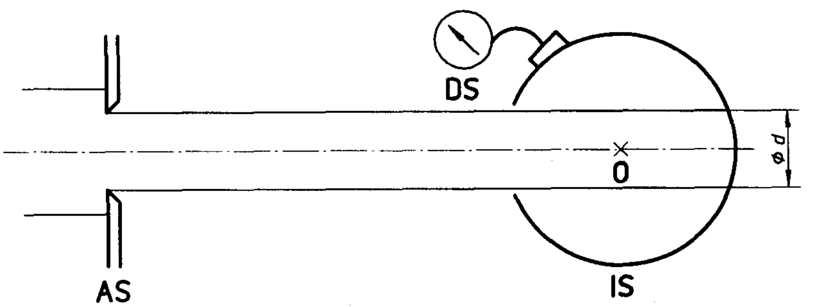
5.3 The bandwidth shall be less than or equal to the wavelength interval (10 nm, or 20 nm if spectral variation is less than 0,2 % per nanometre).

6 Procedure

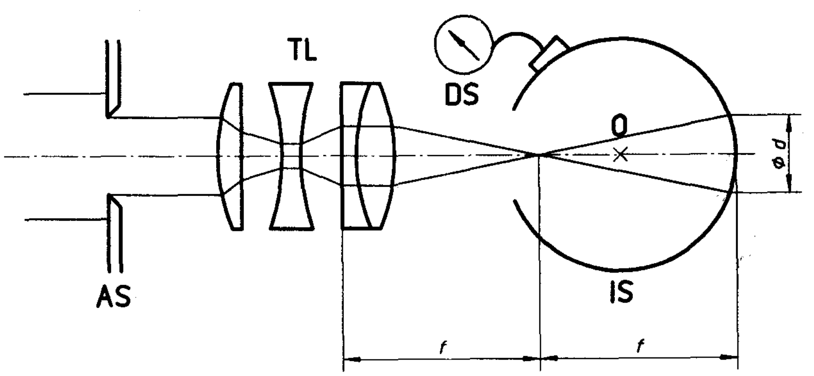
For each wavelength within the range (see clause 5), proceed as follows.

6.1 Set the monochromator wavelength control to obtain monochromatic radiation of the required wavelength λ.

6.2 Adjust the diameter of the aperture stop so that the beam diameter equals (50 ± 5) % of the nominal diameter of the entrance pupil of the lens to be tested. See figure 2.



a) Measuring incident radiant flux



b) Measuring transmitted radiant flux

Key

AS Aperture stop
IS Integrating sphere
d Diameter of beam on rear wall of integrating sphere
DS Detector system
TL Lens under test
f Focal length of the lens under test
O Centre of integrating sphere

Figure 2 — Measurement of spectral transmittance (detection end shown only)

6.3 Measure and record the detector output, which is proportional to $\Phi_{i,\lambda}$.

6.4 Insert the lens to be tested in the optical path with the front surface of the lens (side surface of the object) facing the aperture stop. See figure 2.

6.5 The position of the lens shall be such that the beam size requirements, with and without the lens in position, shall be maintained to a tolerance of ± 50 % as depicted in figures 2a) and 2b). The distance between the aperture stop and the lens, and that between the lens and the entrance port of the integrating sphere, shall be such that inter-reflections between the surface of the lens and the aperture stop, and those between the lens surface and the entrance pupil, shall not introduce any error in the measurement.

6.6 Measure and record the detector output, which is proportional to $\Phi_{\tau,\lambda}$ (with the lens in position).

6.7 Divide the output with the lens in position (step 6.6) by that with the lens removed from the optical path (step 6.3) to obtain the spectral transmittance

$$\tau(\lambda) = \frac{\Phi_{\tau,\lambda}}{\Phi_{i,\lambda}}$$

6.8 Repeat steps 6.1 to 6.7 for each wavelength.

7 Presentation of the results

The transmittance values measured according to the method specified in this International Standard shall be designated as "ISO spectral transmittance" or denoted as

ISO/$\tau(\lambda)$.

The transmittance values shall be stated to two places of decimals and given in the form of a table and/or graph. The measurement error shall be stated.

The following information concerning the lens shall also be supplied:

a) brand name;

b) manufacturer;

c) serial number;

d) marked focal length;

e) focal-length setting (if zoom lens);

f) marked *f*-number;

g) date the measurements were taken;

h) comment on the cleanliness of the lens and if it was necessary to clean the surfaces before testing.

Annex A
(normative)

Method for measuring spectral transmittance of mirror lenses

A.1 Apparatus

The apparatus shall be the same as that for ordinary camera lenses, with the exception that the integrating sphere shall be movable in a plane perpendicular to the optical axis.

A.2 Procedure of measurement

For each wavelength within the range (see clause 5), proceed as follows.

a) Set the monochromator wavelength control to obtain monochromatic radiation of the required wavelength λ.

b) Adjust the diameter of the aperture stop so that the beam diameter equals (50 ± 5) % of the nominal diameter of the entrance pupil of the lens to be tested, as shown in figures A.1 a) and A.1 c).

c) Measure and record the detector output, which is proportional to $\Phi_{i,\lambda}$.

d) Insert the lens to be tested in the optical path with the front surface of the lens (side surface of the object) facing the aperture stop. See figures A.1 a) and A.1 b).

e) The position of the lens shall be such that the location and diameter of the beam incident on the rear wall of the integrating sphere is the same as, or at least ± 50 % of, that without the lens in the optical path as depicted in figures A.1 a) and A.1 b).

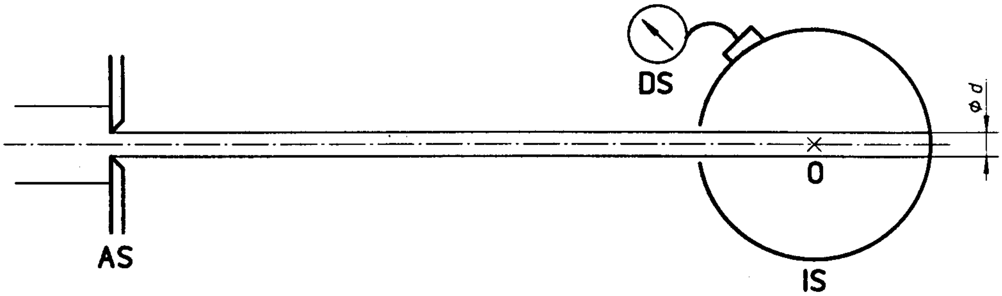
f) Measure and record the detector output, which is proportional to $\Phi_{\tau,\lambda}$.

g) Divide the output with the lens in position [step d)] by that with the lens removed [step c)] to obtain the spectral transmittance.

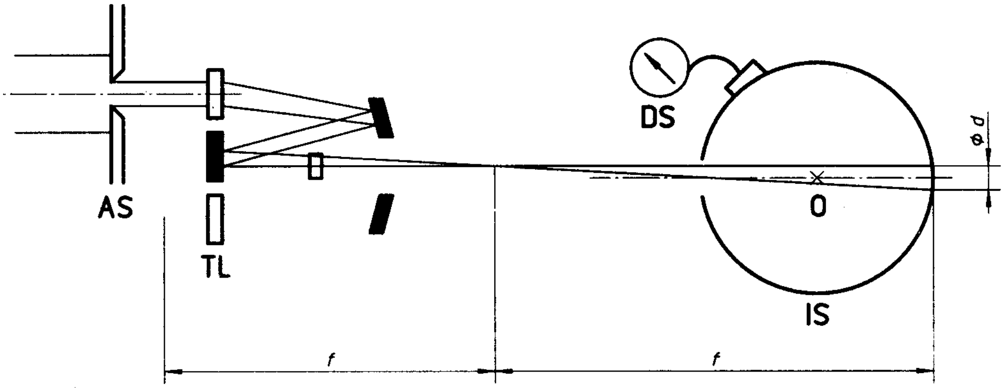
$$\tau(\lambda) = \frac{\Phi_{\tau,\lambda}}{\Phi_{i,\lambda}}$$

NOTE — Any non-uniformity on the mirror may influence the measurements. Therefore, it is suggested that the measurement be repeated using three locations on the mirror, each separated by 120°. Results should be presented for all orientations.

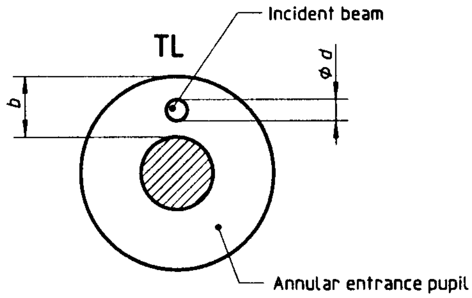
h) Repeat steps a) to g) for each wavelength λ.



a) Measuring incident radiant flux



b) Measuring transmitted radiant flux



$d = b/2$

c) Diameter of the incident beam

Key

AS	Aperture stop	TL	Lens under test	*f*	Focal length of the system under test
IS	Integrating sphere	O	Centre of integrating sphere	*b*	Radial width of the annular entrance pupil
DS	Detector system	*d*	diameter of beam		

Figure A.1 — Measurement of the spectral transmittance of mirror lenses

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Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

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Amendments Issued Since Publication

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