

INTERNATIONAL
STANDARD

ISO
8599

First edition
1994-12-01

**Optics and optical instruments — Contact
lenses — Determination of the spectral
and luminous transmittance**

*Optique et instruments d'optique — Lentilles de contact —
Détermination du facteur spectral de transmission et du facteur relatif de
transmission dans le visible*



Foreword

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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.

International Standard ISO 8599 was prepared by Technical Committee ISO/TC 172, *Optics and optical instruments*, Subcommittee SC 7, *Ophthalmic, endoscopic, metrological instruments and test methods*.

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Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

Optics and optical instruments — Contact lenses — Determination of the spectral and luminous transmittance

1 Scope

This International Standard specifies a method for determining the spectral transmittance and the luminous transmittance of contact lenses.

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 8320:1986, *Optics and optical instruments — Contact lenses — Vocabulary and symbols.*

3 Definitions

For the purposes of this International Standard, the definitions given in ISO 8320 and the following definitions apply.

3.1 spectral transmittance, $\tau(\lambda)$: Ratio of the transmitted spectral radiant flux, $\Phi_{e\lambda\tau}$, to the incident spectral radiant flux, $\Phi_{e\lambda}$:

$$\tau(\lambda) = \frac{\Phi_{e\lambda\tau}}{\Phi_{e\lambda}} \quad \dots (1)$$

where

$$\Phi_{e\lambda} = \frac{d\Phi_e}{d\lambda}$$

$$\Phi_{e\lambda\tau} = \frac{d\Phi_{e\tau}}{d\lambda}$$

3.2 luminous transmittance, τ : Ratio of the transmitted luminous flux, Φ_{τ} , to the incident luminous flux, Φ :

$$\tau = \frac{\Phi_{\tau}}{\Phi}$$

$$= \frac{\int_{\lambda=380 \text{ nm}}^{780 \text{ nm}} (\Phi_{e\lambda})_{\text{rel}} \tau(\lambda) V(\lambda) d\lambda}{\int_{\lambda=380 \text{ nm}}^{780 \text{ nm}} (\Phi_{e\lambda})_{\text{rel}} V(\lambda) d\lambda} \quad \dots (2)$$

4 Principle

4.1 Spectral transmittance

In practice, the measurement of the spectral transmittance, $\tau(\lambda)$, is taken over a small range of wavelength $\Delta\lambda$, for which the associated radiant flux $\Delta\Phi_e$ is given by $\Delta\Phi_e = \Phi_{e\lambda}\Delta\lambda$. In order to determine the spectral transmittance, $\tau(\lambda)$, the radiant flux relative to the wavelength both with and without the contact lens is measured and $\tau(\lambda)$ calculated from equation (1).

4.2 Luminous transmittance

In the case of luminous transmittance, the relative spectral luminous efficiency, $V(\lambda)$, of the human eye is the criterion for the assessment of the radiation.

The value of Φ is always dependent upon the relative spectral distribution of the radiator used (illuminant), which is given by $(\Phi_{e\lambda})_{\text{rel}}$. For this reason, the standard illuminant has to be indicated.

The luminous transmittance, τ , is determined from spectral transmittance values $\tau(\lambda)$ using equation (2). The luminous transmittance, τ , can also be measured with a receiver simulating the relative spectral luminous efficiency, $V(\lambda)$, of the human eye. In this case, standard illuminant A has to be used.

If the instrument used to measure luminous transmittance is not of the integrating type, discrete transmittance measurements are taken at least every 10 nm. The luminous transmittance, τ , can then be calculated by approximating the integrals in equation (2) by finite sums:

$$\tau = \frac{\Phi_{\tau}}{\Phi}$$

$$= \frac{\sum_{\lambda=380 \text{ nm}}^{780 \text{ nm}} (\Phi_{e\lambda})_{rel} \tau(\lambda) V(\lambda)}{\sum_{\lambda=380 \text{ nm}}^{780 \text{ nm}} (\Phi_{e\lambda})_{rel} V(\lambda)} \quad \dots (3)$$

5 Apparatus

The instruments used to measure luminous transmittance shall have, throughout the range of measurement, a bandwidth $\Delta\lambda$ of 10 nm or less, centred on the wavelength λ under measurement.

6 Set up

6.1 Conditions

The measurement of transmittance of contact lenses shall be performed in saline solution. This is done so that the measured value represents the performance of the lens *in vivo* by simulating light losses due to reflection at the lens/tear layer interface by a lens/saline solution interface.

6.2 Arrangement

An example of an arrangement for carrying out the measurement is shown in figure 1.

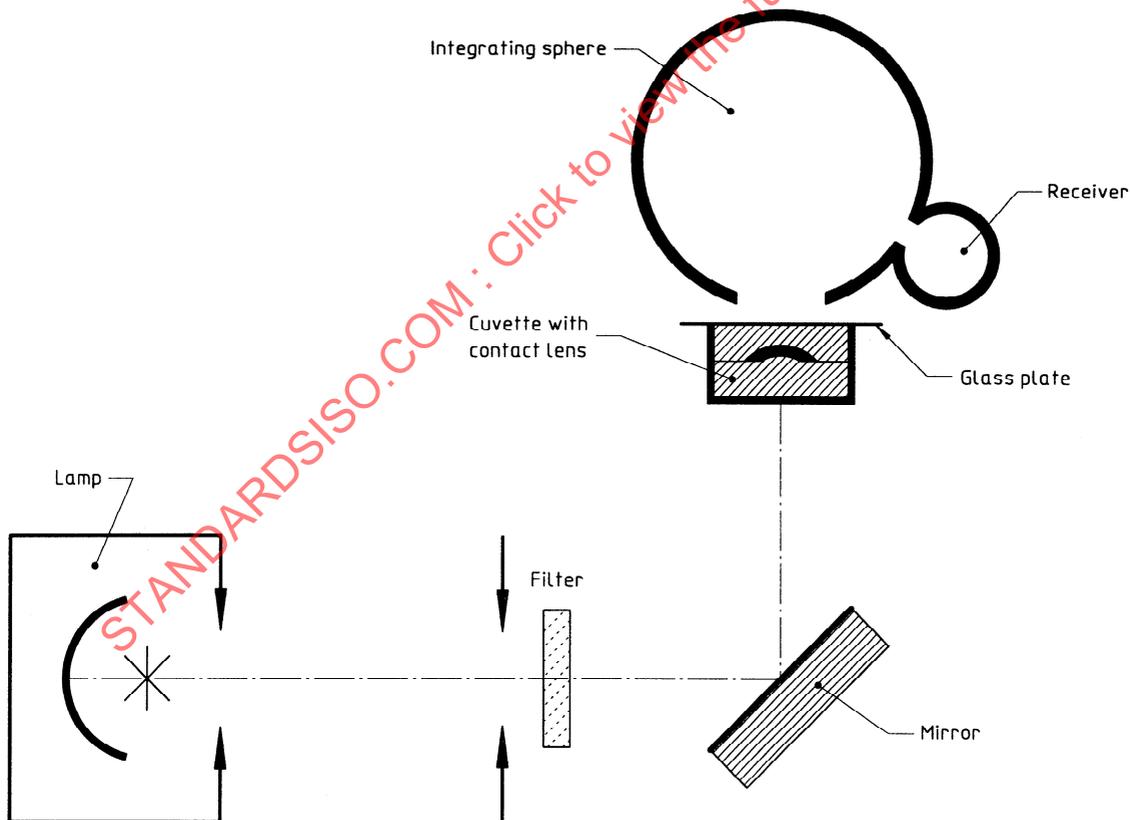


Figure 1 — Example of an arrangement for measuring the transmittance of contact lenses in standard saline solution

6.3 Positioning cuvette

Contact lenses and standard saline solution have similar densities. Thus a special cuvette is helpful (see figure 2) for positioning the contact lenses perpendicular to the incident parallel beam during the measurement. The contact lens is positioned on a circular diaphragm of 6 mm diameter using a centring ring. To obtain a constant depth of standard saline solution, the cuvette is closed with a glass plate.

7 Procedure

Carry out the measurements with the contact lens fully hydrated in standard saline solution in the measuring cuvette, and make the transmittance measurements with a parallel beam of diameter 6 mm, perpendicular to the contact lens.

Measure the intended values both with and without the contact lens. Calculate $\tau(\lambda)$ or τ from equation (1), (2) or (3).

NOTE 1 The luminous transmittance of many lenses has been measured in air. To correct these values to "measured

in standard saline solution" values, the difference in surface reflections between the standard saline solution and the air method has to be taken into account. This is done by using the Fresnel transmittance formula for a dielectric interface under normal incidence:

$$T = \frac{4n_1n_2}{(n_1 + n_2)^2}$$

where n_1 and n_2 are the refractive indices of the two materials.

The converted luminous transmittance is then calculated as follows:

$$\tau_{\text{saline}} = M\tau_{\text{air}}$$

where

$$M = \left(\frac{(n_{\text{air}} + n_{\text{cl}})^2}{(n_{\text{saline}} + n_{\text{cl}})^2} \cdot \frac{n_{\text{saline}}}{n_{\text{air}}} \right)^2$$

$$n_{\text{air}} = 1$$

n_{saline} is the refractive index of the standard saline solution;

n_{cl} is the refractive index of the contact lens material.

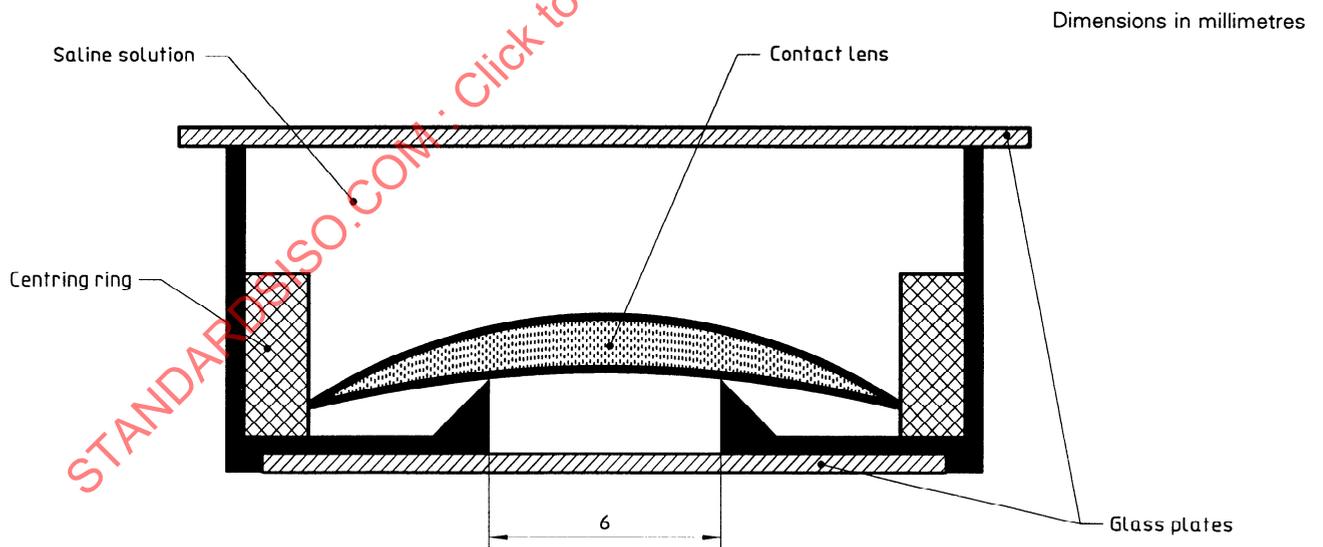


Figure 2 — Cuvette for measuring the transmittance of contact lenses in standard saline solution

8 Test report

The test report shall contain at least the following information:

- a) a reference to this International Standard;
- b) the identification of the contact lens tested;
- c) a description of the apparatus used;
- d) the standard illuminant used;
- e) the result of the test, τ and/or $\tau(\lambda)$;
- f) the date of the test.

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