SLOVENSKI STANDARD
SIST EN 167:1996

01-december-1996

Osebno varovanje oči - Metode optičnih preskusov

Personal eye-protection - Optical test methods

Persönlicher Augenschutz - Optische Prüfverfahren

Protection individuelle de l'oeil - Méthodes d'essais optiques

Ta slovenski standard je istoveten z: EN 167:1995

ICS:

13.340.20 Varovalna oprema za glavo Head protective equipment

SIST EN 167:1996 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 167

May 1995

ICS 13.340.10

Descriptors: Safety, accident prevention, eyes, eye-glasses, oculars, optical tests, inspection, specifications, measurement

English version

Personal eye-protection - Optical test methods

Protection individuelle de l'oeil - Méthodes d'essais optiques

Persönlicher Augenschutz - Optische Prüfverfahren

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart,36 B-1050 Brussels

Ref. No. EN 167:1995 E

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Foreword

This European Standard has been prepared by the Technical Committee CEN/TC 85 "Eye-protective equipment" of, which the secretariat is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 1995, and conflicting national standards shall be withdrawn at the latest by November 1995.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EC Directive(s).

According to the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

This European Standard specifies optical test methods for eye-protectors, the requirements for which are contained in other EN's. Alternative methods may be used if shown to be equivalent.

Non-optical test methods are given in EN 168.

A definition of terms is given in EN 165.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 165	Personal eye-protection - Vocabulary
EN 166:1995	Personal eye-protection - Specifications
EN 168:1995	Personal eye-protection - Non-optical test methods

3 Test for spherical, astigmatic and prismatic refractive powers

NOTE : The reference methods for assessment of refractive power are contained in 3.1 and 3.2. If during measurement using the telescope a doubling or other aberration of the image is observed then the ocular may either be classified as a defective, or subjected to further examination using the method described in annex A.

3.1 Testing unmounted oculars covering one eye

3.1.1 Apparatus

3.1.1.1 Telescope

A telescope with an aperture of nominally 20 mm and a magnification between 10 and 30, fitted with an adjustable eyepiece incorporating a reticular.

3.1.1.2 Illuminated target

A target, consisting of a black plate incorporating the cut-out pattern shown in figure 1, behind which is located a light source of adjustable luminance with a condenser, if necessary, to focus the magnified image of the light source on the telescope objective.

The large annulus of the target has an outer diameter of (23,0 ± 0,1) mm with an annular aperture of (0,6 ± 0,1) mm. The small annulus has an inner diameter of (11,0 ± 0,1) mm with an annular aperture of (0,6 ± 0,1) mm. The central aperture has a diameter of (0,6 ± 0,1) mm. The bars are nominally 20 mm long and 2 mm wide with a nominal 2 mm separation.

3.1.1.3 Filter

A filter with its maximum transmittance in the green part of the spectrum may be used to reduce chromatic aberrations.

3.1.1.4 Calibration lenses

Lenses with positive and negative spherical refractive powers of 0,06 m^{-1}, 0,12 m^{-1} and 0,25 m^{-1} (tolerance ± 0,01 m^{-1}).

3.1.2 Arrangement and calibration of apparatus

The telescope and illuminated target are placed on the same optical axis (4,60 ± 0,02) m apart.

The observer focuses the reticule and the target and aligns the telescope to obtain a clear image of the pattern. This setting is regarded as the zero point of the focusing scale of the telescope.

The focusing adjustment of the telescope is calibrated with the calibration lenses (see 3.1.1.4) so that a power of 0,01 m^{-1} may be measured. Any other equivalent calibration method may be used.

3.1.3 Procedure

The ocular is positioned normal to the telescope axis. Measurements are taken at the points specified in sub-clause 7.1.2.1.1 of EN 166:1995.

3.1.3.1 Spherical refractive power and astigmatic refractive power

3.1.3.1.1 Oculars without astigmatic refractive power

The telescope is adjusted until the image of the target is perfectly resolved. The spherical power of the ocular is then read from the scale of the telescope.

3.1.3.1.2 Oculars with astigmatic refractive power

The target, or the ocular, is rotated in order to align the principal meridians of the ocular with the bars of the target. The telescope is focused firstly on one set of bars (measurement D_1) and then on the perpendicular bars (measurement D_2). The spherical power is the mean, $\frac{D_1 + D_2}{2}$, the astigmatic refractive power is the absolute difference, $|D_1 - D_2|$, of the two measurements.

3.1.3.2 Prismatic refractive power

The ocular to be tested is placed in front of the telescope, and, if the point of intersection of the lines of the reticule falls outside the image of the large circle, the prismatic power exceeds 0,25 cm/m. If the point of intersection of the lines of the reticule falls inside the image of the small circle of the target, the prismatic power is less than 0,12 cm/m.

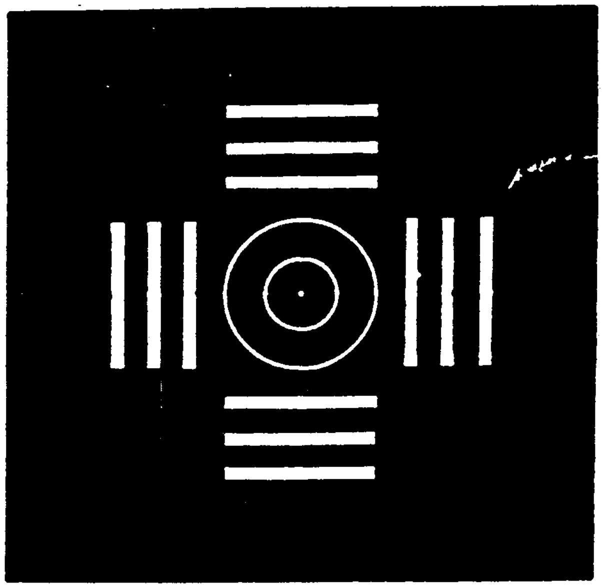

Figure 1: Telescope target (dimensions are given in 3.1.1.2)

3.2 Testing unmounted oculars covering both eyes and mounted oculars (spectacles, goggles and face-shields)

3.2.1 Determination of the spherical and astigmatic refractive power

The spherical and astigmatic powers are determined for each eye in accordance with the procedure described in 3.1.3.1 with the eye protector mounted in front of the telescope as worn and using a nominal pupillary distance of 64 mm.

3.2.2 Determination of the difference in prismatic refractive power

3.2.2.1 Apparatus

The arrangement of the reference method is shown in figure 2.

3.2.2.2 Procedure

The diaphragm LB_1, illuminated by the light source, is adjusted in such a way that it produces an image on the plane B when the eye-protector (P) is not in position. The eye-protector is placed in front of the lens L_2 so that the axis of the eye-protector is parallel to the optical axis of the test assembly. Adjustable tilt eye-protectors are positioned with their oculars normal to the optical axis of the test equipment.

Measure the vertical and horizontal distances between the two displaced images arising from the two ocular regions of the eye-protector.

These distances in centimeter are divided by 2 to give the horizontal and vertical prismatic differences in centimeter per meter.

If the light paths which correspond to the two eye regions cross, the prismatic refractive power is 'base in' and if the light paths do not cross, it is 'base out'.

Dimensions in millimeters
(nominal unless toleranced)

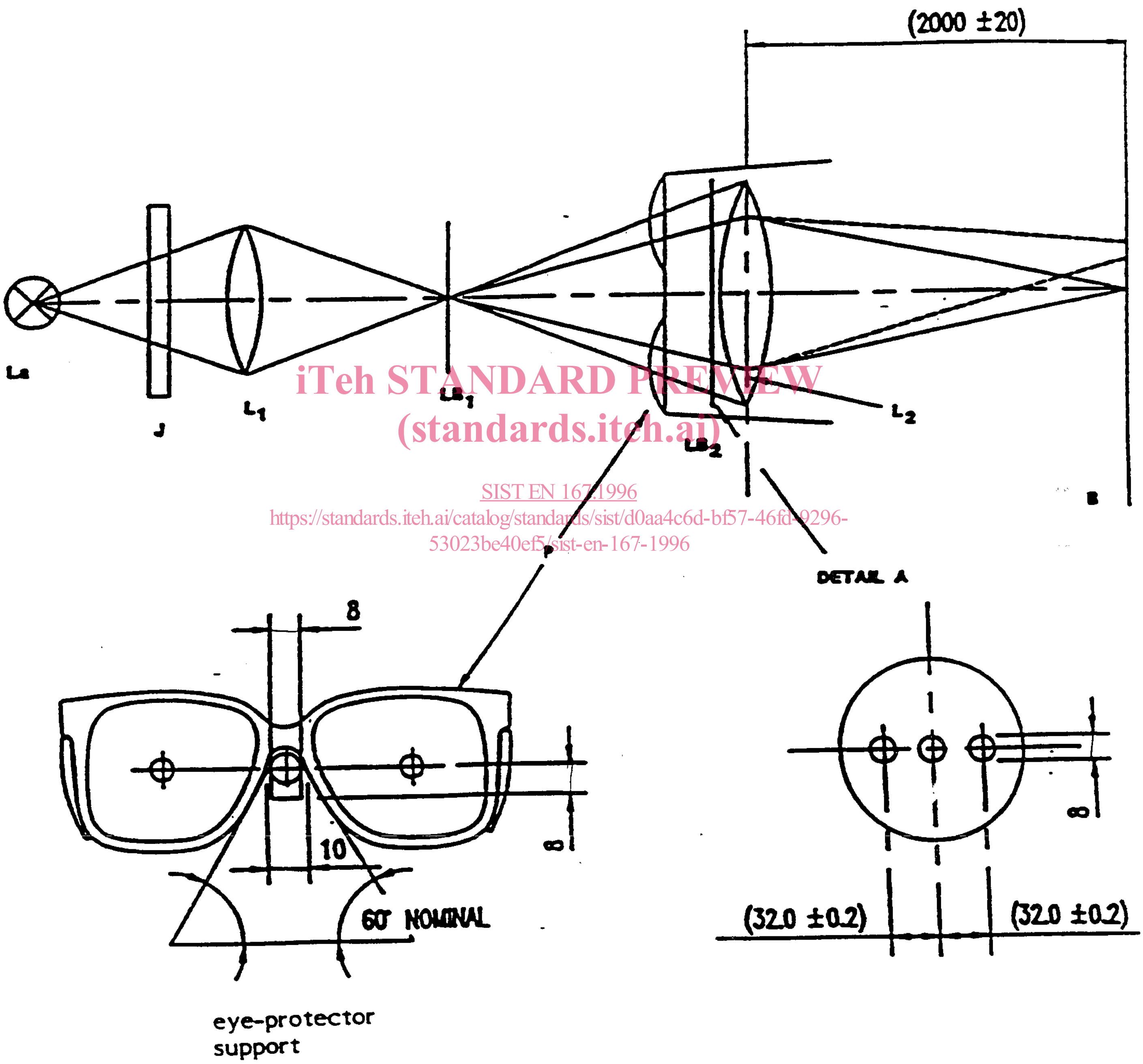

Figure 2 : Arrangement of apparatus for measurement of prismatic difference

L_a light source, for example, small filament lamp, laser with wavelength of (600 ± 70) nm, etc.

J interference filter with peak transmittance in the green part of the spectrum (required only if a filament lamp is used as the light source).

L_1 achromatic lens, focal length between 20 mm and 50 mm.

LB_1 diaphragm, diameter of aperture 1 mm nominal.

P eye-protector.

LB_2 diaphragm as shown in detail A.

L_2 achromatic lens, 1000 mm nominal focal length and 75 mm nominal diameter.

B image plane.

4 Light diffusion test

4.1 Principle

The luminance (L_s) of an illuminated ocular is a measure of its light diffusion and is proportional to the illuminance (E). The proportionality factor is the luminance factor $l = L_s/E$, which is expressed in candelas per square metre per lux $\frac{(cd/m^2)}{lx}$.

To obtain a factor l* which is independent of the transmittance of the ocular, the luminance factor is divided by the transmittance τ.

$$l^* = \frac{L_s}{\tau E}$$

This quantity is known as the reduced luminance factor and is expressed in the same units as the luminance factor.

NOTE : Most oculars have diffusion properties which are symmetrical about the optical axis. For these oculars, the mean value of the reduced luminance factor is constant within an angle limited by the two cones shown in figure 3. This mean value depends upon values α and $\Delta\alpha$.

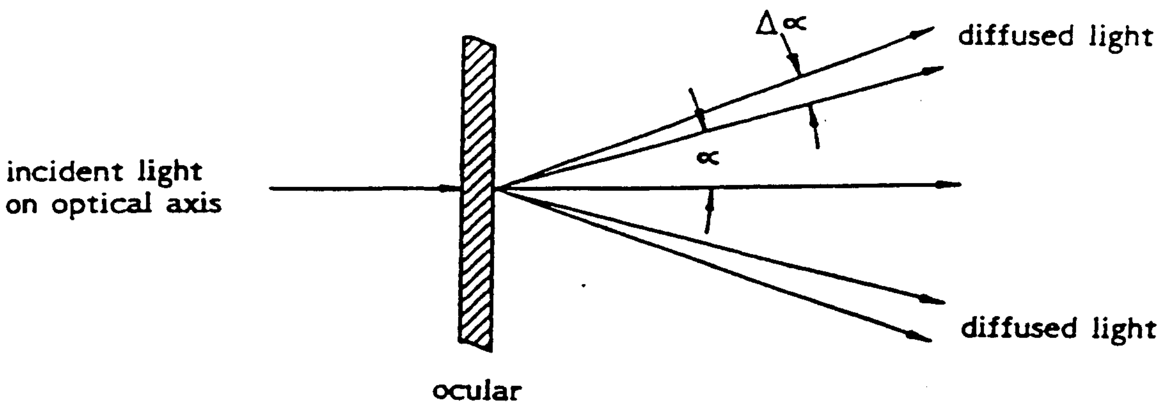

Figure 3: Diffusion angles

4.2 Test methods

Two reference test methods are specified which use the same measurement principle. The 'basic method' detailed in 4.2.1 may be used for oculars without corrective effect and for all shade numbers.

The 'simplified method' detailed in 4.2.2 has to be used for oculars with corrective effect and may also be used for other oculars up to a shade number of 4 to 6 depending on the sensitivity of the measuring apparatus.

The results obtained with the two methods may be considered to be equivalent; whichever method is used the relative measurement uncertainty for the reduced luminance factor shall not be greater than 25 %.

4.2.1 Basic method

4.2.1.1 Apparatus

The arrangement is shown in figure 4.

The spherical mirror H_1 forms an image of light L of identical dimensions at diaphragm LB. The concave mirror H_3 forms an image of diaphragm LB in the plane of diaphragms B_L and B_R. The achromatic lens A is positioned immediately behind the diaphragm so that a reduced image of the test sample in position P appears on diffusing screen MS. The image of iris diaphragm IB_1 is formed at the same time as IB_2.

The arrangement collects all the light originating from the filter between angles $\alpha = 1{,}5°$ and $\alpha + \Delta\alpha = 2°$ in relation to the optical axis.