



SLOVENSKI STANDARD
oSIST prEN ISO 9342-1:2022
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**Optika in optični instrumenti - Preskusne leče za umerjanje fokometrov – 1. del:
Referenčne leče za fokometre, ki se uporabljajo za merjenje spektralnih leč
(ISO/DIS 9342-1:2022)**

Optics and optical instruments - Test lenses for calibration of focimeters - Part 1:
Reference lenses for focimeters used for measuring spectacle lenses (ISO/DIS 9342-
1:2022)

Optik und optische Instrumente - Prüfgläser zur Kalibrierung von Scheitelbrechwert-
Messgeräten - Teil 1: Referenzgläser für Scheitelbrechwert-Messgeräte für die Messung
von Brillengläsern (ISO/DIS 9342-1:2022)

Optique et instruments d'optique - Verres étalons pour l'étalonnage des frontofocomètres
- Partie 1: Verres de référence pour frontofocomètres pour le mesurage des verres de
lunettes (ISO/DIS 9342-1:2022)

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Optics and optical instruments — Test lenses for calibration of focimeters —

Part 1: Reference lenses for focimeters used for measuring spectacle lenses

*Optique et instruments d'optique — Verres étalons pour l'étalonnage des frontofocomètres —
Partie 1: Verres étalons pour frontofocomètres pour le mesurage des verres de lunettes*

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 172, *Optics and photonics*, Subcommittee SC 7, *Ophthalmic optics and instruments*.

This second edition cancels and replaces the first edition (ISO 9342-1:2005), which has been technically revised.

A list of all parts in the ISO 9342 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Optics and optical instruments — Test lenses for calibration of focimeters —

Part 1: Reference lenses for focimeters used for measuring spectacle lenses

1 Scope

This part of ISO 9342 specifies requirements for reference lenses for the calibration and verification of focimeters that are used for the measurement of spectacle form lenses. It also gives a method for the determination of the back vertex power of the reference lenses.

NOTE It is accepted that other reference lenses can also be used with powers within the given range, manufactured to the same standard of accuracy and form, but different back vertex powers. However, only lenses with integer nominal powers, as described in paragraph 4.1, can be used for the calibration of digitally-rounding focimeters.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7944, *Optics and optical instruments — Reference wavelengths*

ISO 8598-1, *Optics and optical instruments — Focimeters — Part 1: General purpose instruments*

ISO 13666, *Ophthalmic optics — Spectacle lenses — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13666 as well as the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

back vertex power

reciprocal of the paraxial value of the back vertex focal length

Note 1 to entry: According to ophthalmic convention, the “power” of a lens is specified as the *back vertex power*.

Note 2 to entry: The unit for expressing focal length is the metre and for vertex power is the reciprocal metre (m⁻¹). The name for this unit is “diopetre”, and the symbol is “D”.

[SOURCE: ISO 13666:2019, 3.10.8, modified by adding note 2 to entry.]

ISO/DIS 9342-1:2022(E)**3.2****reference lens**

lens complying with this document used for the calibration and verification of focimeters

3.3**spherical reference lens**

lens with spherical front and back surfaces used for the calibration and verification of dioptric power measurements by focimeters

Note 1 to entry: A surface of plano power is a special case of a spherical surface having an infinite radius of curvature.

3.4**prismatic reference lens**

prismatic lens constructed with two plane surfaces used for the calibration and verification of prismatic power measurements by focimeters

Note 1 to entry: The unit for expressing prismatic power is centimetres deviation per metre distance (cm/m). The name for this unit is "prism dioptre" and the symbol is "Δ".

Note 2 to entry: The prism shall be constructed to give the correct deviation with light incident perpendicular to one surface.

3.5**cylindrical reference lens**

lens with one plane surface and one cylindrical surface used to calibrate and verify the axis indicator and axis marker with reference to the orientation of the adjusting rail

3.6**spherocylindrical-power reference lens**

lens with one spherical surface and one toroidal surface that are used to check the non-symmetric cylinder power and cylinder axis error given by an automated focimeter after calibration

3.7**reference filter**

neutral density filter of plano power that is used to check the capability of an automated focimeter to measure tinted lenses

3.8**surface power**

capacity of an optical surface to change the curvature of incident wavefronts by refraction

Note 1 to entry: Back surface power is given by the formula:

$$F_{BS} = (1 - n)/r_2$$

where

F_{BS} is the back surface power in D;

n is the refractive index of the material of the lens, and

r_2 is the radius of curvature of the back surface in metres, regarded as being positive if the centre of curvature is behind the surface according to the direction of travel of light through the surface.

[SOURCE: ISO 13666:2019, 3.2.10, modified by the deletion of 'of a lens' and 'or deviation' and the addition of Note 1 to entry.]

3.9

verified power

<of a reference lens> power derived from measurements of the parameters of the reference lens

Note 1 to entry: Each verified power comes with an uncertainty. This uncertainty is derived from the uncertainties of the individual measurements used to establish the verified power and must be within the values specified in this document.

Note 2 to entry: An example for the set of parameters to be measured for a spherical reference lens, are the refractive index, radii of curvature of the two surfaces and thickness (see [Annex A](#)). For a prismatic reference lens, an example for a set of parameters to be measured are the refractive index and its apical angle (i.e. the angle between its two surfaces). (See [Annex B](#)).

Note 3 to entry: These parameters are measured using procedures and/or equipment traceable to certificates issued by an appropriate metrology laboratory

4 Design requirements and recommendations for reference lenses

4.1 General

All reference lenses shall be made of homogeneous white crown glass selected to be free of bubbles and striae in an area of 4 mm radius surrounding the centre of the aperture.

Other materials may also be used provided their use results in lenses with a durability and optical reproducibility within the given tolerance over time and that can be manufactured to the same standard of uncertainty and form as the glass lenses specified above.

The reference wavelength for the reference lenses used to calibrate and calculate the conventional power value of the back vertex power shall be stated. The reference wavelengths shall be either the green mercury e line ($\lambda_e = 546,07$ nm) or the yellow helium d-line ($\lambda_d = 587,56$ nm).

The conventional power value of a reference lens is defined as a calculated value, which is based on actual measurements of the individual design parameters of the reference lens, such as refractive index, radius of curvature of lens surface, etc. These are measured using procedures and/or equipment traceable to certificates issued by an appropriate metrology laboratory. An appropriate metrology laboratory may be one accredited to ISO 17025 for these measurements or one specified in national or regional regulations.

NOTE The reference lenses should have protective mounts, which are designed so that, when a lens is correctly placed on the lens support, the focimeter is not obstructed. It is recommended that the verified power value of the power of the lens and the reference wavelength be marked on the mount.

4.2 Spherical reference lenses

4.2.1 Standard reference lenses

For a complete set of spherical reference lenses, the following set of nominal back vertex powers is recommended:

-25 D, -20 D, -15 D, -10 D, -5 D, +5 D, +10 D, +15 D, +20 D, +25 D

The spherical reference lenses should have an aperture of at least 15 mm.

In order to minimize the influence of spherical aberration, the curvature of the back surface and the centre thickness shall approximately correspond to those of normal spectacle lenses. [Table 1](#) gives nominal back surface powers and ranges for centre thickness, which will ensure that the reference lenses are of this form.

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Table 1 — Design range for the standard spherical reference lenses

Nominal back vertex power D	Range for back surface power D	Range for centre thickness ^a mm
-25	-26 to -24	2 to 6
-20	-21 to -19	2 to 6
-15	-16 to -14	2 to 6
-10	-13 to -11	2 to 8
-5	-10 to -8	2 to 8
+5	-6 to -4	3 to 7
+10	-4 to -2	3 to 7
+15	-2 to 0 ^b	5 to 7
+20	-1 to 0 ^b	7 to 9
+25	-1 to 0 ^b	9 to 11

^a The centre thicknesses are required to guarantee stability in the negative power range.

^b The back surface shall not be convex

4.2.2 Low power reference lenses (optional)

When validating automated instruments, it is recommended to add extra, low, powers into the range. Suggested values can be found in Table 2.

Table 2 — Design range for the low power spherical reference lenses

Nominal back vertex power D	Nominal back surface power D	Power range for back surface power	Range for centre thickness ^a mm
-2,5 -0,25 ^b -0,12 ^b +0,12 ^b +0,25 ^b +2,5	-6	± 1	2 to 8

^a The centre thicknesses are required to guarantee stability in the negative power range.

^b Choose either +0,25 and -0,25 or +0,12 and -0,12.

4.3 Prismatic reference lenses

The optical surfaces of prismatic reference lenses shall be plane and their aperture shall be at least 15 mm.

The number of prismatic reference lenses that should be used to adjust or to check a focimeter depends on the measuring range of the instrument. The prismatic power marked on the mount shall be the power for light incident normal to the surface resting on the lens support.

For a complete set, the following set of prismatic powers is recommended:

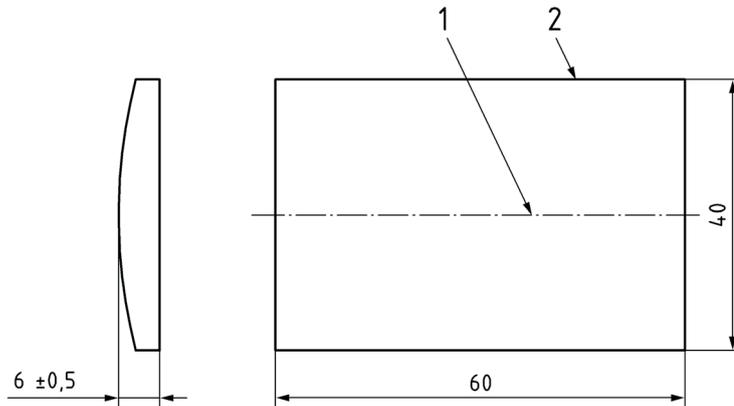
2 Δ 5 Δ 10 Δ 15 Δ 20 Δ

NOTE The prismatic value may depend on the design of the focimeter (IOA or FOA – see ISO 13666) due to the implications of incident angle. This is explained in ISO/TR 29890.

4.4 Cylindrical reference lenses

This reference lens shall be a positive plano-cylindrical lens of at least 5 D edged to a rectangular shape and shall have the dimensions, nominal unless otherwise stated, shown in [Figure 1](#). The cylinder axis shall be parallel to the longer, reference, side of the rectangle and shall be marked by a centre line. The reference side shall also be marked.

Dimensions in millimetres



Key

- 1 Centre line
- 2 Reference side/edge

Figure 1 — Cylindrical reference lens

4.5 Spherocylindrical-power reference lenses

Spherocylindrical-power reference lenses are used to test automated focimeters that measure sphere power, cylinder power, and cylinder axis simultaneously for non-symmetric cylinder power and cylinder axis errors. They are specially mounted spherocylindrical-power lenses with a power of $-2,00$ D sph/ $-1,50$ D cyl, of spectacle form and quality conforming to ISO 8980-1, and shall have a diameter of not less than 25 mm.

The spherocylindrical-power reference lens is centred and firmly affixed on to an octagonal disk so that the optical centre of the lens is coincident with the geometrical centre of the disk. The length of the sides of the disk shall be between 25 mm and 30 mm. The axis of the cylinder should be aligned as close as practicable to one of the faces of the disk. The disk shall have a clear central aperture of at least 10 mm diameter centred on the geometrical centre of the disk. The disk is constructed of metal or rigid plastic at least 3 mm in thickness.

An illustration of the specially mounted spherocylindrical-power reference lens with the disk is shown in [Figure 2](#).

As an alternative to using a lens mounted on an octagonal disc, a lens may be edged to the same octagonal shape. The length of the sides of the edged lens shall be between 20 mm and 25 mm in order to have stable and accurate measurements. The optical centre of the edged lens shall be coincident with its geometrical centre.