INTERNATIONAL STANDARD

ISO 21987

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Ophthalmic optics — Mounted spectacle lenses

Optique ophtalmique — Verres ophtalmiques montés

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Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established 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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 21987 was prepared by Technical Committee ISO/TC 172, *Optics and photonics*, Subcommittee SC 7, *Ophthalmic optics and instruments*.

Ophthalmic optics — Mounted spectacle lenses

1 Scope

This International Standard specifies requirements for mounted spectacle lenses relative to the prescription order.

2 Normative references

The following referenced documents are indispensable for the application 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 8429, *Optics and optical instruments — Ophthalmology — Graduated dial scale*

ISO 8598, *Optics and optical instruments — Focimeters*

ISO 8624, *Ophthalmic optics — Spectacle frames — Measuring system and terminology*

ISO 8980-1, *Ophthalmic optics — Uncut finished spectacle lenses — Part 1: Specifications for single-vision and multifocal lenses*

ISO 8980-2, *Ophthalmic optics — Uncut finished spectacle lenses — Part 2: Specifications for progressive-power lenses*

ISO 8980-3, *Ophthalmic optics — Uncut finished spectacle lenses — Part 3: Transmittance specifications and test methods*

ISO 8980-4, *Ophthalmic optics — Uncut finished spectacle lenses — Part 4: Specifications and test methods for anti-reflective coatings*

ISO 8980-5, *Ophthalmic optics — Uncut finished spectacle lenses — Part 5: Minimum requirements for spectacle lens surfaces claimed to be abrasion-resistant*

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

ISO 14889:2003, *Ophthalmic optics — Spectacle lenses — Fundamental requirements for uncut finished lenses*

3 Terms and definitions

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

4 Classification

Finished, mounted lenses are classified as follows:

a) single-vision finished lenses;

b) multifocal finished lenses;

c) progressive-power and degressive-power finished lenses.

5 Requirements

5.1 Reference temperature

The tolerances shall apply at a temperature of 23 °C ± 5 °C.

5.2 Lenses used in manufacturing complete spectacles

Lenses used in manufacturing complete spectacles shall meet the requirements of ISO 14889:2003, 4.1, 4.2, 4.3.1, 4.3.2 and 4.5. Lenses shall also have been shown to meet the requirements ISO 14889:2003, 4.4 unless a national standard or law specifies mechanical strength requirements, in which case the national standard or law will take precedence.

ISO 14889:2003, 4.1 requires that the uncut finished lenses used in manufacturing complete spectacles comply with the relevant parts of ISO 8980.

Lenses in mounted spectacles shall also comply with other requirements of the prescription order not included in this International Standard.

5.3 Optical requirements

5.3.1 General

The optical characteristics shall be determined using a focimeter complying with ISO 8598.

Where the power is measured in the presence of more than 0,50 Δ the optical power shall be the off-axis power.

The optical tolerances shall apply at the reference point(s) of the lenses at either of the reference wavelengths specified in ISO 7944.

If the manufacturer has applied corrections to compensate for the “as-worn” position, then the tolerances shall apply to this “as-worn” corrected dioptric power.

5.3.2 Back vertex power tolerance

The tolerances in Table 1 apply to all single-vision lenses and the distance portion of multifocal lenses, including those with aspherical or atoroidal surfaces. The tolerances in Table 2 apply to the distance portion of progressive-power lenses and the near portion of degressive-power lenses. The back vertex power shall be measured using the method described in 6.2.

5.3.3 Cylinder axis direction tolerance

The direction of the cylinder axis shall be measured using the method described in 6.3, and shall be specified in accordance with ISO 8429. The tolerances on the direction of the cylinder axis are specified in Table 3.

NOTE 1 To allow for some tolerance in mounting, the tolerance on the direction of cylinder axis has generally been increased over the tolerances found in the ISO uncut finished lens standards ISO 8980-1 and ISO 8980-2.

NOTE 2 Compensation for the “as-worn” position might result in cylinder powers of less than 0,12 D, in which case there are no applicable axis tolerances.

5.3.4 Addition power tolerance for multifocal and progressive-power lenses

The addition power shall be measured using the method described in 6.4. The tolerances on addition power are specified in Table 4.

Table 1 — Tolerances on the back vertex power of single-vision and multifocal lenses

Values in dioptres

Power of principal meridian with higher absolute back vertex power	Tolerance on the back vertex power of each principal meridian	Tolerance of the cylindrical power			
		⩾ 0,00 and ⩽ 0,75	> 0,75 and ⩽ 4,00	> 4,00 and ⩽ 6,00	> 6,00
⩾ 0,00 and ⩽ 3,00	± 0,12	± 0,09	± 0,12	± 0,18	—
> 3,00 and ⩽ 6,00	± 0,12	± 0,12	± 0,12	± 0,18	± 0,25
> 6,00 and ⩽ 9,00	± 0,12	± 0,12	± 0,18	± 0,18	± 0,25
> 9,00 and ⩽ 12,00	± 0,18	± 0,12	± 0,18	± 0,25	± 0,25
> 12,00 and ⩽ 20,00	± 0,25	± 0,18	± 0,25	± 0,25	± 0,25
> 20,00	± 0,37	± 0,25	± 0,25	± 0,37	± 0,37

Table 2 — Tolerances on the back vertex power of progressive- and degressive-power lenses

Values in dioptres

Power of principal meridian with higher absolute back vertex power	Tolerance on the back vertex power of each principal meridian	Tolerance of the cylindrical power			
		⩾ 0,00 and ⩽ 0,75	> 0,75 and ⩽ 4,00	> 4,00 and ⩽ 6,00	> 6,00
⩾ 0,00 and ⩽ 6,00	± 0,12	± 0,12	± 0,18	± 0,18	± 0,25
> 6,00 and ⩽ 9,00	± 0,18	± 0,18	± 0,18	± 0,18	± 0,25
> 9,00 and ⩽ 12,00	± 0,18	± 0,18	± 0,18	± 0,25	± 0,25
> 12,00 and ⩽ 20,00	± 0,25	± 0,18	± 0,25	± 0,25	± 0,25
> 20,00	± 0,37	± 0,25	± 0,25	± 0,37	± 0,37

Table 3 — Tolerances on the direction of cylinder axis

Absolute cylindrical power dioptres	⩾ 0,125 and ⩽ 0,25	> 0,25 and ⩽ 0,50	> 0,50 and ⩽ 0,75	> 0,75 and ⩽ 1,50	> 1,50 and ⩽ 2,50	> 2,50
Tolerance on the axis direction degrees	± 16	± 9	± 6	± 4	± 3	± 2

Table 4 — Tolerances on the addition power for multifocal and progressive-power lenses

Values in dioptres

Value of the addition power	⩽ 4,00	> 4,00
Tolerance	± 0,12	± 0,18

5.3.5 Prism imbalance (relative prism error) for pairs of single-vision and multifocal lenses

After neutralizing or allowing for any prescribed prism, the tolerances as given in Table 5 shall be met when tested in accordance with the method given in 6.7.

To determine the prism imbalance:

1) resolve any ordered prism to its horizontal and vertical components;

2) find four principal powers (two in each lens);

3) identify the minimum absolute power from the four principal powers;

4) enter Figure 1 with that power (the X-axis) and find horizontal imbalance tolerance (the Y-axis), using the curve representing the relevant range that contains the higher value ordered prism component;

5) enter Figure 2 with that power (the X-axis) and find vertical imbalance tolerance (the Y-axis), using the curve representing the relevant range that contains the higher value ordered prism component.

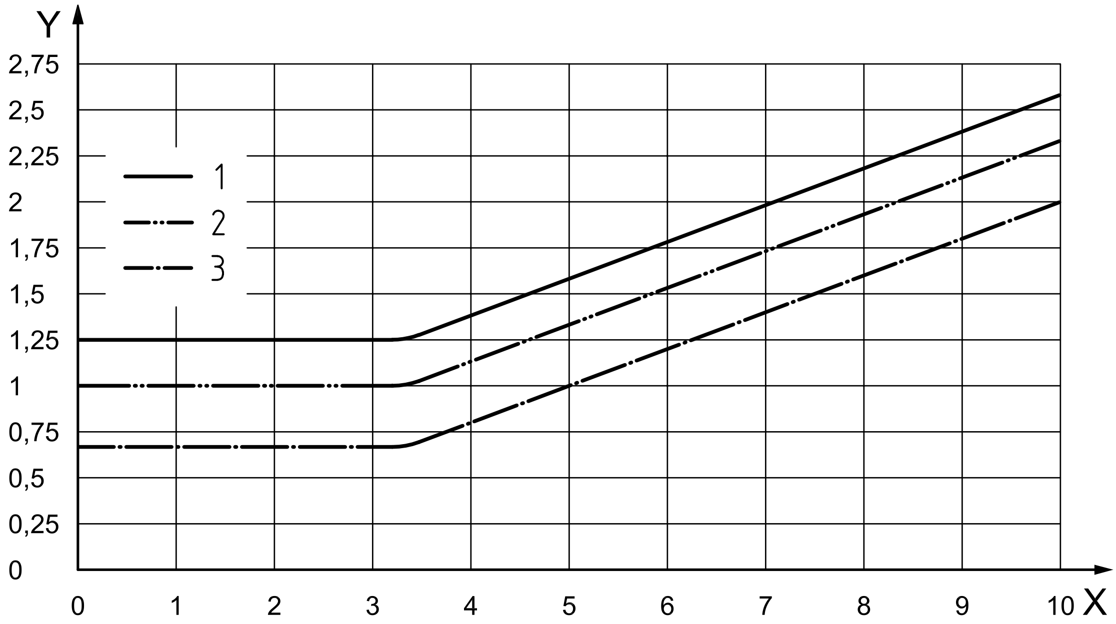
Table 5 — Prism imbalance (relative prism error) tolerances for single-vision and multifocal lenses

Higher absolute ordered component prism value Δ	Tolerance on the horizontal component (Relative to the ordered centration distance)	Tolerance on the vertical component (Relative to the ordered centration distance)
⩾ 0,00 to ⩽ 2,00	For powers[a] ⩾ 0,00 to ⩽ 3,25 D 0,67 Δ For powers[a] > 3,25 D the prismatic effect of 2,0 mm displacement	For powers[a] ⩾ 0,00 to ⩽ 5,00 D 0,50 Δ For powers[a] > 5,00 D the prismatic effect of 1,0 mm displacement
> 2,00 to ⩽ 10,00	For powers[a] ⩾ 0,00 to ⩽ 3,25 D 1,00 Δ For powers[a] > 3,25 D 0,33 Δ + the prismatic effect of 2,0 mm displacement	For powers[a] ⩾ 0,00 to ⩽ 5,00 D 0,75 Δ For powers[a] > 5,00 D 0,25 Δ + the prismatic effect of 1,0 mm displacement
> 10,00	For powers[a] ⩾ 0,00 to ⩽ 3,25 D 1,25 Δ For powers[a] > 3,25 D 0,58 Δ + the prismatic effect of 2,0 mm displacement	For powers[a] ⩾ 0,00 to ⩽ 5,00 D 1,00 Δ For powers[a] > 5,00 D 0,50 Δ + the prismatic effect of 1,0 mm displacement

[a] These tolerances are applied to the lowest absolute principal power of the pair of lenses.

5.3.6 Prism imbalance (relative prism error) for progressive-power lenses and degressive-power lenses

Positioning of progressive-power lenses and degressive-power lenses within the specifications of this International Standard will produce prism imbalance errors consistent with wearer needs. It is essential that the individual prism errors of each lens, measured at the prism reference point, do not exceed the tolerances given in ISO 8980-2.



Key

1 > 10,00 Δ

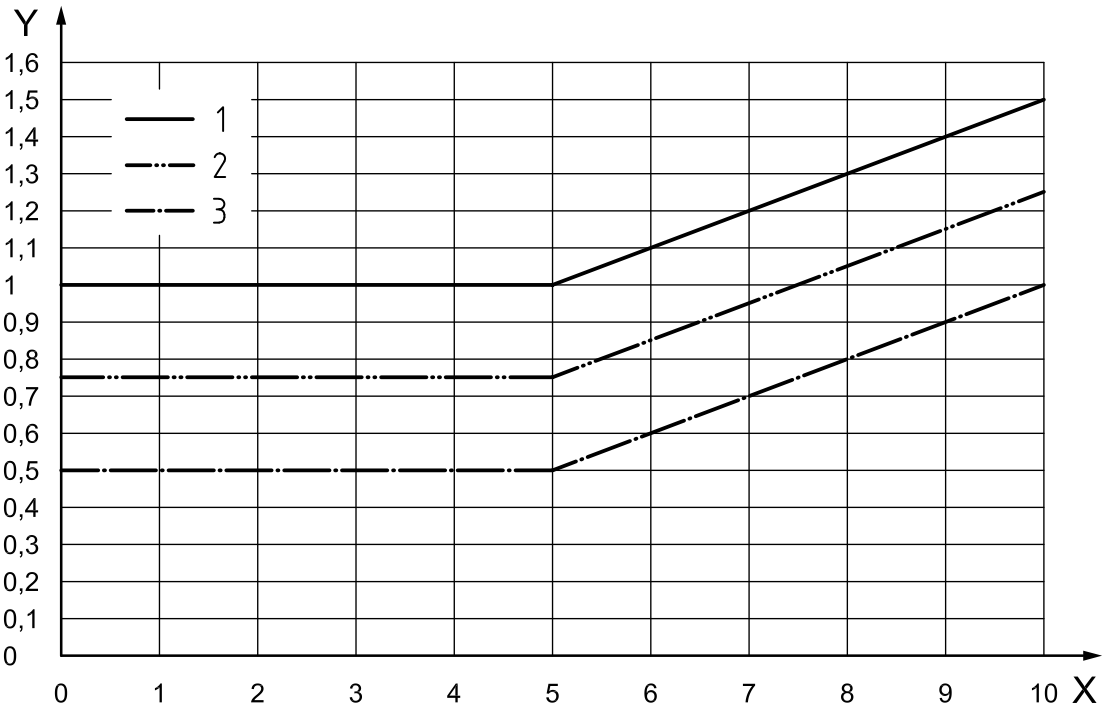
2 > 2,00 Δ to ⩽ 10,00 Δ

3 ⩾ 0,00 Δ to ⩽ 2,00 Δ

X minimum absolute principal power (dioptres, D)

Y prism imbalance tolerance (prism dioptres, Δ)

Figure 1 — Horizontal prism imbalance (relative prism error) tolerances for lenses with higher absolute ordered component prism values of ⩾ 0,00 Δ to ⩽ 2,00 Δ, > 2,00 Δ to ⩽ 10,00 Δ and > 10,00 Δ



Key

1 > 10,00 Δ

2 > 2,00 Δ to ⩽ 10,00 Δ

3 ⩾ 0,00 Δ to ⩽ 2,00 Δ

X minimum absolute principal power (dioptres, D)

Y prism imbalance tolerance (prism dioptres, Δ)

Figure 2 — Vertical prism imbalance (relative prism error) tolerances for lenses with higher absolute ordered component prism values of ⩾ 0,00 Δ to ⩽ 2,00 Δ, > 2,00 Δ to ⩽ 10,00 Δ and > 10,00 Δ

5.4 Thickness tolerance

The thickness of the lens may be specified by the manufacturer or be agreed between the orderer and the supplier.

Thickness shall be measured at the reference point of the front surface and normal to this surface. It shall not deviate from the ordered or agreed value by more than ± 0,3 mm.

5.5 Positioning tolerances

5.5.1 Multifocal lenses

5.5.1.1 Vertical positions (or heights) of the segments

The segment extreme point positions (s in Figure 3) [or segment heights (h in Figure 3)] shall be within ± 1,0 mm of that ordered. In addition, the difference between segment heights for the mounted pair shall not exceed 1,0 mm relative to any difference ordered. Measurement shall be made using the method specified in 6.5.

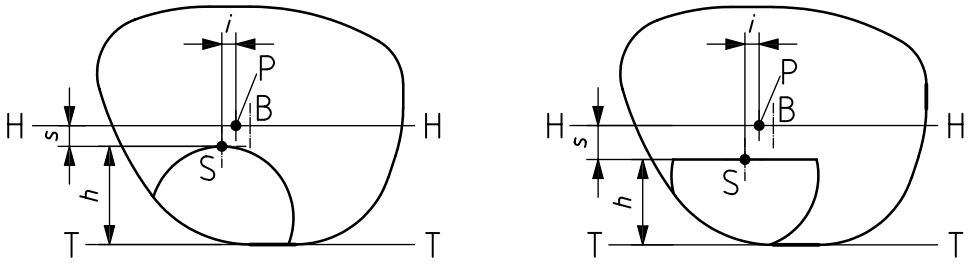
NOTE The measurement point for an E-style multifocal segment is the point on the dividing line at which the height of the ledge between the distance and near portions is at a minimum.

5.5.1.2 Horizontal position of the segments

The horizontal position of the segment extreme point S shall be $i \pm 1{,}0$ mm from the ordered monocular centration points P where i is the geometrical inset (see Figure 3). Measurement shall be made using the method specified in 6.5.

NOTE 1 The horizontal position of both segments should appear symmetrical and balanced unless unequal monocular centration distances or geometrical insets are ordered.

NOTE 2 The measurement point for an E-style multifocal segment is the point on the dividing line at which the height of the ledge between the distance and near portions is at a minimum.



Key

B boxed centre of the edged lens shape
HH horizontal centreline
P distance centration point
S segment extreme point
TT horizontal tangent to the peak of the bevel (if any) of the edge of the lens at its lowest point
h segment height
i geometrical inset
s segment extreme point position

Figure 3 — Positions of centration points and segment extreme points in multifocal lenses

5.5.1.3 Segment tilt for straight-top and curved-top segments

The orientation of the dividing line shall not be tilted more than 2° from the horizontal when measured using the methods specified in 6.5.

5.5.2 Progressive-power and degressive-power lenses

5.5.2.1 Vertical position (or height) of the fitting point

The vertical position of the fitting point or fitting point height shall be within $\pm 1{,}0$ mm of that ordered. In addition, the difference between fitting point heights for the mounted pair shall not exceed 1,0 mm relative to any difference specified. Measurement shall be made using the method specified in 6.5.

5.5.2.2 Horizontal position of the fitting point

The horizontal fitting point position shall be within $\pm 1{,}0$ mm of the ordered monocular centration distance for that lens. Measurement shall be made using the method specified in 6.5.

5.5.2.3 Alignment marking tilt

The line joining the permanent alignment reference markings shall not be tilted more than 2° from the horizontal when measured using the methods specified in 6.5.