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Ophthalmic optics — Mounted spectacle lenses

Optique ophtalmique — Verres ophtalmiques montés

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Contents

Page

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 21987:2009), which has been technically revised.

Ophthalmic optics — Mounted spectacle lenses

1 Scope

This document specifies requirements and test methods for mounted spectacle lenses relative to the prescription order.

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 8429, *Optics and optical instruments — Ophthalmology — Graduated dial scale*

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

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 power-variation lenses*

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

ISO 14889, *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 and the following apply.

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

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
power-variation lens
spectacle lens with a smooth variation of focal power over part or all of its area, without discontinuity, designed to provide more than one focal power

Note 1 to entry: These are usually designed to provide increasing or decreasing spherical power, typically in a vertical meridian, so as to provide correction for different object distances.

Note 2 to entry: Examples of *power-variation lenses* are, but not limited to, *progressive-power lenses* (3.2) and *degressive-power lenses* (3.3).

3.2
progressive-power lens
PPL
progressive-addition lens
PAL
varifocal lens
power-variation lens (3.1) with two reference points for focal power, generally designed to provide correction for presbyopia and clear vision from distance to near

Note 1 to entry: *Progressive-power lenses* have a *primary reference point* (3.5) that is the distance reference point and a *secondary reference point* (3.6) that is the near reference point.

3.3
degressive-power lens
power-variation lens (3.1) with a *primary reference point* (3.5) for near vision, generally designed to provide clear vision from near to further distances

3.4
position-specific single-vision lens
single-vision lens, generally with complex surface geometry, that needs to be positioned accurately according to the ordered specification and bears permanent alignment reference markings

Note 1 to entry: An example for *position-specific single-vision lenses* are those single-vision lenses calculated to take into account the as-worn position and therefore requiring accurate mounting in front of the wearer's eye.

3.5
primary reference point
point on the front surface of a *power-variation lens* (3.1) at which the *verification power* (3.8) for the designed primary use of the lens applies

Note 1 to entry: All *power-variation lenses* have a *primary reference point*.

Note 2 to entry: For example, the *primary reference point* for a *progressive-power lens* (3.2) is the distance reference point and for a *degressive-power lens* (3.3) is the near reference point.

3.6
secondary reference point
point on the front surface of a *power-variation lens* (3.1) at which the *verification power* (3.8) for the designed secondary use of the lens applies

Note 1 to entry: Some *power-variation lenses* can have a *secondary reference point* (3.6) that is used for the determination of the addition power or *variation power* (3.7).

Note 2 to entry: For example, the *secondary reference point* for a *progressive-power lens* (3.2) is the near reference point.

3.7
variation power
<for a *power-variation lens*> difference between the vertex powers at the *primary* (3.5) and *secondary reference points* (3.6)

Note 1 to entry: For example, for a *progressive-power lens* (3.2), this is the addition power, while for some *degressive-power lenses* (3.3), it is the degression power.

Note 2 to entry: *Variation power* is defined for *power-variation lenses* (3.1) only if they have both a *primary* and a *secondary reference point*.

3.8
verification power
dioptric power of the lens, specifically calculated and provided by the manufacturer as the reference for focimeter verification

Note 1 to entry: This is the power that is expected to be found as the measured power using the specified method, and to which the tolerances apply.

Note 2 to entry: The *verification power* can differ from the ordered power, for example, because the ray path through the lens when being measured on a focimeter can be different from that in the as-worn position, and because of (ocular) physiological effects.

Note 3 to entry: If only one power is stated by manufacturer with the finished uncut or mounted lenses, then this will be the ordered power and is to be used for verification.

4 Classification

Finished, mounted lenses are classified as follows:

a) single-vision finished lenses;

b) multifocal finished lenses;

c) power-variation 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

Uncut finished lenses used in manufacturing complete spectacles shall meet the requirements of ISO 14889.

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

5.3 Optical requirements

5.3.1 General

The optical characteristics shall be verified using a focimeter conforming to the requirements of ISO 8598-1.

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

If the manufacturer states a verification power, then the ranges and tolerances in Table 1, Table 2 Table 3, and Table 4 shall be chosen according to and applied to the verification power. In this case, the verification power may be stated by the manufacturer in an accompanying document.

5.3.2 Back vertex power

When verified according to 5.3.1, spectacle lenses shall comply with the tolerances on the power of each principal meridian (see Table 1, second column), and with the tolerances on the cylindrical power (see Table 1, third to sixth column), using the method specified in 6.2:

— the back vertex power at the reference point of all single-vision lenses and the distance reference point of multifocal lenses, including those with aspherical or atoroidal surfaces, shall comply with the tolerances in Table 1;

— the back vertex power at the primary reference point of power-variation lenses shall comply with the tolerances in Table 2.

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

Values in dioptres (D)

Power of principal meridian with higher absolute back vertex power	Tolerance on the back vertex power of each principal meridian	Tolerance on the absolute 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 at the primary reference point of power-variation lenses

Values in dioptres (D)

Power of principal meridian with higher absolute back vertex power	Tolerance on the back vertex power of each principal meridian	Tolerance on the absolute 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

5.3.3 Direction of the cylinder axis

When verified according to 5.3.1 and using the method specified in 6.3, the direction of the cylinder axis shall comply with the tolerances specified in Table 3. The cylinder axis shall be specified in accordance with ISO 8429.

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

NOTE 2 There are no requirements for the axis direction for cylindrical powers of less than 0,12 D.

Table 3 — Tolerances on the direction of the cylinder axis

Absolute cylindrical power dioptres (D)	<0,12	≥0,12 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 direction of the cylinder axis degrees (°)	No requirement	±16	±9	±6	±4	±3	±2

5.3.4 Addition power or variation power

For multifocal lenses and those power-variation lenses with primary and secondary reference points, the following shall apply. When verified according to 5.3.1 and using the method specified in 6.4, the addition or variation power shall comply with the tolerances specified in Table 4.

Table 4 — Tolerances on the addition power or variation power

Values in dioptres (D)

Value of the addition power or variation power	≤4,00	>4,00
Tolerance	±0,12	±0,18

5.3.5 Prism imbalance (relative prism error) for mounted single-vision lenses (excluding position-specific single-vision lenses) and multifocal lenses

When verified according to 5.3.1 and using the method specified in 6.6, the prism imbalance (relative prism error), after neutralizing or allowing for any prescribed prism, for single-vision (excluding position-specific single-vision) lenses and multifocal lenses shall comply with the tolerances in Table 5. Lenses with no ordered prism are also included.

To determine the prism imbalance tolerances:

1) if ordered as an oblique prism, resolve any ordered prism into its horizontal and vertical components;

2) determine the higher of the ordered horizontal component values and the higher of the ordered vertical component values;

3) find the four principal powers (two in each lens);

4) identify the highest absolute power from the four principal powers;

5) horizontal: if the absolute value of the power found in 4) is ≤3,37 D, use the tolerance values in the second column of Table 5. The row is determined using the higher of the ordered horizontal component values. If the absolute value of the power is >3,37 D, use the tolerance values in the third column;

   NOTE Figure 1 can be used to determine the horizontal prism imbalance tolerance rather than using Table 5. Find the horizontal prism imbalance tolerance on the y-axis using the power from 4) above on the x-axis, and the curve representing the relevant prism range, i.e. that containing the higher ordered horizontal prism component value.

6) vertical: if the absolute value of the power found in 4) is ≤5,00 D, use the tolerance values in the fourth column of Table 5. The row is determined using the higher of the ordered vertical component values. If the absolute value of the power is >5,00 D, use the tolerance values in the fifth column.