INTERNATIONAL STANDARD

ISO 21987

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Ophthalmic optics — Mounted spectacle lenses

Optique ophtalmique — Verres ophtalmiques montés

Reference number
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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.

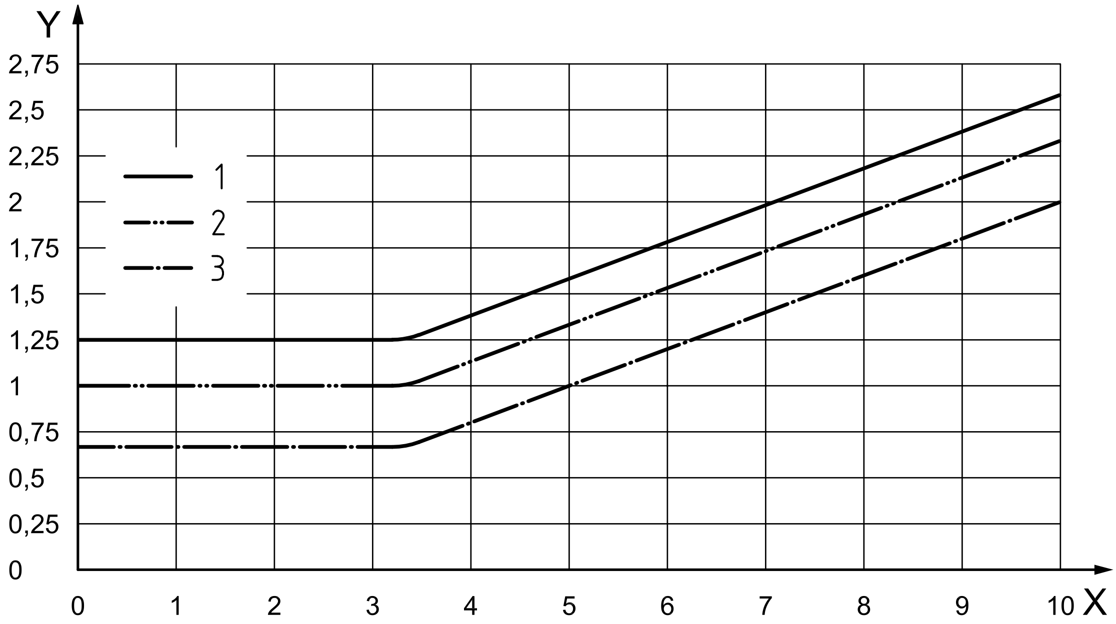
Table 5 — Prism imbalance (relative prism error) tolerances for single-vision and multifocal lenses

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

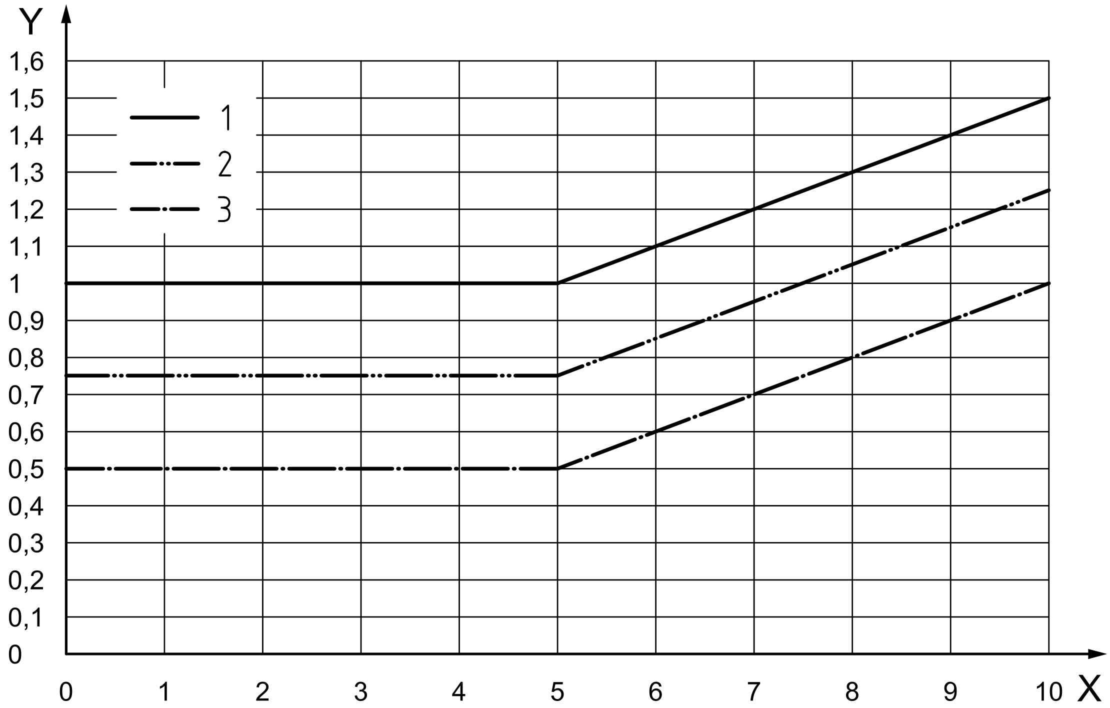
2 > 2,00 Δ to ⩽ 10,00 Δ

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.

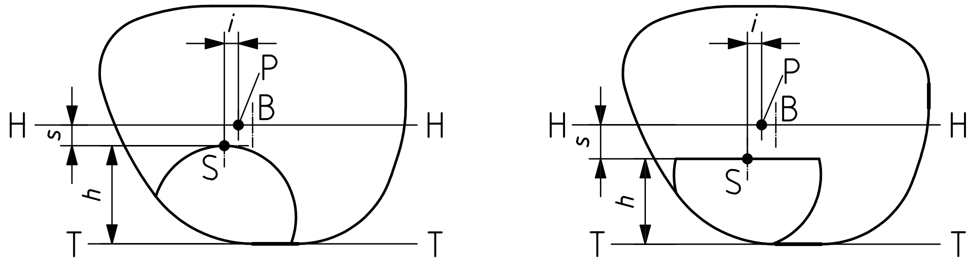
NOTE The measurement point for an E-style multifocal segment is the point on the dividing line at which the height of the ledge between the distance and near portions is at a minimum.

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 ± 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 ± 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.

6 Test methods

6.1 General

Lenses shall be measured using a focimeter conforming to the requirements of ISO 8598.

A lens measured with a focimeter calibrated to the mercury e-line reference wavelength may show a difference in power when compared to the same lens measured at the same point using a focimeter calibrated to the helium d-line.

Alternative measurement methods are acceptable if shown to perform equivalently to the reference test methods shown in this clause.

NOTE 1 Material and surface quality can be assessed using Annex A.

NOTE 2 Recommendations on mounting are given in Annex B.

6.2 Measurement method for the back vertex power of single-vision lenses and the distance portion of multifocal and progressive-power lenses and near portion of degressive-power lenses

Lenses shall be measured with the intended back surface against the focimeter support. The lens shall be centred at the appropriate design reference point. Any errors in the back vertex power shall not exceed the tolerances given in Table 1 and Table 2.

6.3 Measurement method for cylinder axis

Measure the cylinder axis in relation to the horizontal centre line of the spectacle frame by placing the bottom edge of the frame on the focimeter rail. In cases where the positioning of the spectacle frame on the focimeter rail is not possible (e.g. frames with large face-form angle), alternative measurement methods may need to be employed.

6.4 Addition power measurement

6.4.1 Specification of measurement method

Choose the appropriate measurement method from the two addition power measurement methods; front surface and back surface measurement. Unless otherwise stated by the manufacturer, the surface to be placed against the focimeter support shall be the segment or progressive side.

NOTE 1 In the case of an aspheric multifocal lens, the distance reference point should be specified by the manufacturer.

NOTE 2 Differences may exist between front surface and back surface measurements.

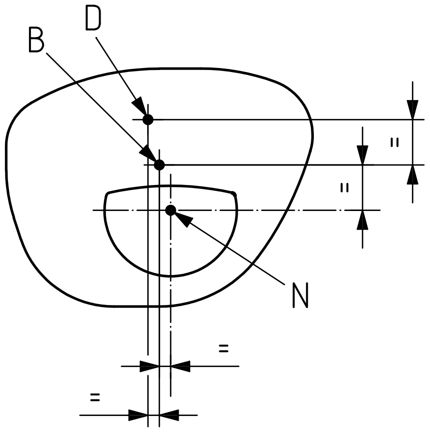
6.4.2 Front surface method for addition power measurement for multifocal lenses

For each lens, establish point D, which is the symmetrical point of N with respect to B (see Figure 4). If the position of point N is not specified, choose a point 5 mm below the top of the segment as point N.

Place the lens so that the front surface is against the focimeter lens support; position the lens at point N, and measure the near power.

Keeping the front surface against the focimeter support, position the lens at D (see Figure 4) and measure the distance power.

Calculate the addition power as the difference between the near power and the distance power. Near power and distance power may be either the power measured using the nearer to vertical lines of the target or the spherical equivalent power.



Key

B distance reference point

D distance vertex power measurement point

N near measurement point

Figure 4 — Measurement of the addition power

6.4.3 Back surface method for addition power measurement for multifocal lenses

For each lens, establish point D which is the symmetrical point of N with respect to B. If the position of point N is not specified, choose a point 5 mm below the top of the segment as point N.

Place the lens so that the back surface is against the focimeter lens support; position the lens at point N, and measure the near power.

Keeping the back surface against the focimeter support, position the lens at D and measure the distance power.

Calculate the addition power as the difference between the near power and the distance power. Near power and distance power may be either the power measured using the nearer to vertical lines of the target or the spherical equivalent power.

6.4.4 Front surface method for addition power measurement for progressive-power lenses

For each lens, place the lens so that the front surface is against the focimeter lens support; position the lens at the near design reference point and measure the near power.

Keeping the front surface against the focimeter support, position the lens at the distance reference point and measure the distance power.

Calculate the addition power as the difference between the near power and the distance power. Near power and distance power may be either the power measured using the nearer to vertical lines of the target or the spherical equivalent power.

6.4.5 Back surface method for addition power measurement for progressive-power lenses

For each lens place the lens so that the back surface is against the focimeter lens support; position the lens at the near design reference point and measure the near power.

Keeping the back surface against the focimeter support, position the lens at the distance reference point and measure the distance power.

Calculate the addition power as the difference between the near power and the distance power. Near power and distance power may be either the power measured using the nearer to vertical lines of the target or the spherical equivalent power.

6.5 Method for measuring position and tilt

Segment location, fitting point position and tilt shall be measured in the plan view of the lens or spectacle front, as appropriate, and in accordance with the boxed lens system of measurement given in ISO 8624. Suitable methods utilize, among others, a shadowgraph optical comparator fitted with the appropriate reticule or precision millimetric measuring instrument.

The positioning and tilt of a progressive- or degressive-power lens shall be verified by reference to the permanent alignment reference markings.

6.6 Material and surface quality

See Annex A.

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

Proceed as follows.

a) Prior to placing the spectacles on the focimeter, mark the ordered centration point on the right and left lenses;

b) measure the horizontal and vertical prism value at the right ordered centration point and the left ordered centration point and determine the horizontal and vertical prism difference (or imbalance) according to the following rules:

   1) for horizontal components (i.e. in or out), add together similar base directions and subtract opposite base directions to determine the horizontal prism imbalance;

   2) for vertical components (i.e. up or down), subtract similar base directions and add opposite base directions to determine the vertical prism imbalance.

NOTE An alternative measurement method is given in Annex C.

7 Marking for progressive-power and degressive-power lenses

7.1 Permanent marking

Each lens shall be permanently marked with at least the following:

a) the alignment reference markings comprising two marks located 34 mm apart, equidistant to a vertical plane through the fitting point or prism reference point;

b) indication of addition power, in dioptres, under the temporal alignment reference marking; degressive-power lenses are excluded from this requirement, but if available in more than one degression power, an appropriate indication shall be given;

c) indication of the manufacturer or supplier or tradename or trademark.

NOTE Some of the permanent markings may disappear by edging.

7.2 Non-permanent marking

Each lens shall be non-permanently marked as applicable with at least the following:

a) the alignment reference marking;

b) indication of the distance design reference point;

c) indication of the near design reference point;

d) indication of the fitting point;

e) indication of the prism reference point.

NOTE Non-permanent markings can be established by soluble inks, decals, electrostatic transparencies, etc.

8 Identification

The information to be stated by the manufacturer in any accompanying document shall comply with Clause 6 of ISO 14889:2003.

9 Reference to ISO 21987

If the manufacturer or supplier claims compliance with this International Standard, reference shall be made to ISO 21987 either on the package or in available literature.

Annex A
(informative)

Material and surface quality

A.1 Assessment

In the inspection zone detailed in item a), b) or c), each lens should not exhibit any defect either internally or on the surfaces, which may impair vision. Outside this zone, small isolated material and/or surface defects are acceptable.

a) Single-vision lenses: the inspection zone is an area 30 mm in diameter centred around the reference point.

b) Multifocal lenses: the inspection zone comprises two areas:

an area of 30 mm in diameter, centred around the distance reference point, and also either the whole area of the segment if the segment is not more than 30 mm in diameter or, for segments over 30 mm in diameter, a 30 mm diameter area centred around the near design reference point.

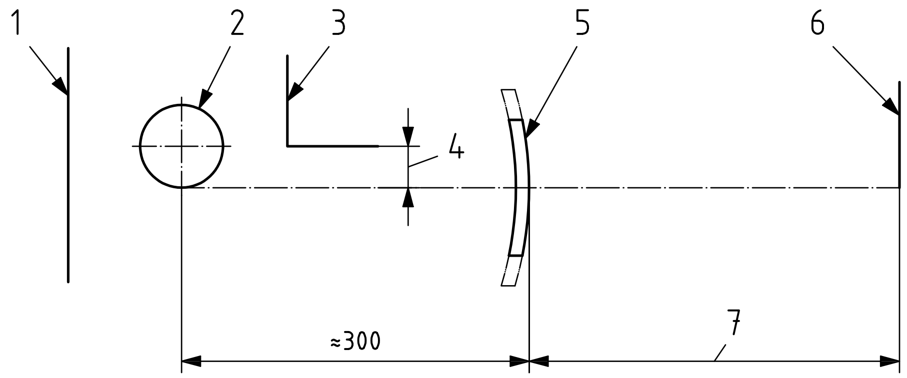
c) Progressive- and degressive-power lenses: the inspection zone is an area of 30 mm in diameter, centred around the prism reference point.

A.2 Test method

Carry out the lens inspection at a light/dark boundary and without the aid of magnifying optics. The recommended system is shown in Figure A.1. Inspect the lens within a room with ambient lighting of about 200 lx. Use a source of at least 400 lm as an inspection lamp, for example a fluorescent tube of 15 W or a partly shaded 40 W incandescent clear lamp.

NOTE This observation is subjective and requires some experience.

Dimensions in millimetres



Key

1 matt black background (150 mm × 360 mm)
2 source of 400 lm minimum
3 diaphragm
4 adjustable opaque mask
5 movable spectacle lens
6 plane of the observer's eye
7 clear vision

NOTE The diaphragm is adjusted to shield the eye from the light source and to allow the lens to be illuminated by the light.

Figure A.1 — Recommended system for visually inspecting a lens for defects

Annex B
(informative)

Recommendations on mounting

B.1 Appearance of lens pairs

B.1.1 Geometrical dimensions

The two lenses of a pair should be reasonably matched in shape, size, form and mass and, except when necessary for matching purposes, should not be substantially thicker than is required to give mechanical stability.

NOTE In certain circumstances, a satisfactory match may require lenses to be specially worked.

B.1.2 Colour matching

The tint, including residual reflectance of anti-reflective coatings and reflectance of mirror coatings, of the two lenses of a pair, should not be obviously dissimilar.

B.2 Recommendations on glazing

B.2.1 Size and shape of lenses

The size and shape of a lens should be substantially the same as the size and shape of the corresponding aperture in the frame.

Care should be exercised to ensure that the dimensions of the spectacle front, after glazing, do not differ substantially from the corresponding dimensions before glazing. It should be borne in mind that significant alterations to rim shape, aperture size or bridge dimensions may considerably shorten the useful life of finished spectacles.

When glazing metal frames, care should be taken not to damage any protective coating on the metal.

B.2.2 Lenses with bevelled edges

The bevel should be smooth, regular, free from chips and starring, and reasonably free from facets, with a safety chamfer at the peak and at each edge where necessary.

B.2.3 Lenses for rimless and semi-rimless spectacle mounts

Flat-edged lenses should present a smooth finish with a neat safety chamfer at each edge where necessary.

Holes for rimless fittings should be drilled at the correct distance from the edge according to the type of mounting. Slots and grooves, when required, should be accurately positioned. Brow-bars of semi-rimless mounts should be carefully adjusted to follow the edge of the lens provided the frame model allows this. The ends of screws should be neatly finished.

B.2.4 Mounting

Lenses should be securely retained in the frame so that movement or rotation cannot occur under any normal condition of use. No gaps should be visible between the edge of the lens and the rim. The halves of closing block joints should close properly without undue force or without leaving a noticeable gap at the joint.

Lenses in rimless and semi-rimless mounts should be neatly and carefully fitted to ensure that they are securely held in position.

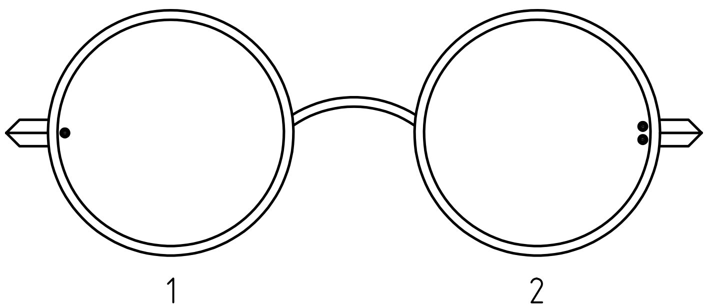
All mounted lenses should show no significant strain when examined in a polariscope or strainviewer.

B.2.5 Setting of round lenses

The setting position of round lenses (except those of thermally-toughened glass) should be indicated by means of a permanent mark placed next to the joint on the back lens surface as follows:

a) on the right lens, one mark on the horizontal centre line at the temporal side;

b) on the left lens, two marks placed symmetrically one above and one below the horizontal centre line at the temporal side (see Figure B.1).



Key

1 right

2 left

Figure B.1 — Front view of round lenses illustrating marks (exaggerated) on back surfaces

Annex C
(informative)

Alternative methods for measuring prism imbalance (relative prism error) for pairs of single-vision and multifocal lenses

C.1 Alternative method 1

The method described in 6.7 can be simplified to that given below when there is less than 2,50 D of oblique cylinder, no ordered difference in vertical position and less than 1,00 D of power difference between lenses.

a) Place the spectacles with the lens of higher absolute power on the focimeter support, and after neutralizing or allowing for any prescribed or thickness reduction prism, dot the distance reference point.

b) After removing the spectacles from the focimeter, measure from that dot and mark the ordered centration distance on the other lens. Keeping the focimeter rail at the same height, replace the spectacles on the focimeter and position the mark on the second lens centrally on the focimeter support. After allowing for any prescribed or thickness reduction prism, the horizontal and vertical prism values read at this point are the prism imbalances.

C.2 Alternative method 2

C.2.1 General

Using the method given below and after neutralizing or allowing for any prescribed prism, the tolerances given in Table C.1, together with the additional tolerances given in Table C.2, when appropriate, should be met.

C.2.2 Initial marking of optical centres on a focimeter or lens analyser

Place the spectacles with the lens of higher absolute power on the focimeter support, and after neutralizing or allowing for any prescribed or thickness reduction prism, dot the distance reference point. Keeping the focimeter rail at the same height, now verify the other lens, centre the image horizontally in the eyepiece and dot the lens. If the focimeter image for the second lens is vertically displaced, note the amount of prism and if this is more than 0,50 Δ then move the second lens vertically until no vertical prism is shown, then re-dot the lens.

C.2.3 Horizontal imbalance

Any error in the horizontal positioning of the optical centres which does not exceed 0,67 Δ or a 2,0 mm error between the ordered centration distance and the distance between the two focimeter dots will pass.

NOTE To check that the horizontal error does not exceed 0,67 Δ, use a precision millimetric measuring instrument and mark the second lens at the ordered centration distance from the focimeter dot on the first lens; replace the spectacles on the focimeter with this mark centred on the focimeter support, and read the prism power.

C.2.4 Vertical imbalance

Any error in the vertical positioning of the optical centres which does not exceed 0,50 Δ or a 1,0 mm error between any ordered difference in lens position and the distance between the two focimeter dots will pass.

Table C.1 — Tolerances on the centration or prism imbalance (relative prism error) for single vision and multifocal lenses incorporating prisms ⩽ 2,00 Δ

Ordered prism component Δ	Horizontal tolerance	Vertical tolerance[a]
⩾ 0,00 to ⩽ 2,00	2,0 mm positioning error or 0,67 Δ prism imbalance (relative prism error) relative to the ordered centration distance[b]	0,50 Δ prism imbalance (relative prism error) or 1,0 mm positioning error at the ordered centration points[b]

[a] If there is an ordered difference in the vertical position of single-vision lenses or multifocal segments, the prism imbalance (relative prism error) or positioning error are measured at the specified centration points.

[b] The values in these two cells are the same as in Table 5, but expressed as positioning error or prism values in order to match the method in C.2.

Table C.2 — Additional tolerance when either or both lenses incorporate prescribed prism > 2,00 Δ

Values in prism dioptres

Ordered prism component	Additional tolerance	
	Horizontal	Vertical
> 2,00 up to ⩽ 10,00	± 0,33	± 0,25
> 10,00	± 0,58	± 0,50

NOTE The increased tolerance is applied only to the relevant component. For example, in a prescription with 4 Δ horizontal and 1 Δ vertical in each lens, the additional tolerance is applied only to the horizontal component.

Bibliography

[1] ISO/TR 28980, *Ophthalmic optics — Spectacle lenses — Parameters affecting lens power measurement*

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