
**Eye and face protection — Test
methods —**

**Part 3:
Physical and mechanical properties**

*Protection des yeux et du visage — Méthodes d'essai —
Partie 3: Propriétés physiques et mécaniques*

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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.

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on 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 ISO/TC 94, *Personal safety — Personal protective equipment*, Subcommittee SC 6, *Eye and face protection*.

This first edition of ISO 18526-3:2019 cancels and replaces ISO 4855:1981, which has been technically revised.

A list of all parts in the ISO 18526 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.

Introduction

This family of documents was developed in response to the worldwide stakeholders' demand for minimum requirements and test methods for eye and face protectors traded internationally. ISO 4007 gives the terms and definitions for all the various product types. The test methods are in the ISO 18526 series, while the requirements for occupational eye and face protectors are in the ISO 16321 series. Eye protection for specific sports is mostly dealt with by the ISO 18527 series. A guidance document, ISO 19734¹⁾, for the selection, use and maintenance of eye and face protectors is in preparation.

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1) Under preparation. Stage at the time of publication: ISO/CD 19734:2020.

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Eye and face protection — Test methods —

Part 3: Physical and mechanical properties

1 Scope

This document specifies the reference test methods for determining the physical and mechanical properties of eye and face protectors.

This document does not apply to any eye and face protection products for which the requirements standard(s) specifies other test methods.

Other test methods can be used if shown to be equivalent and include uncertainties of measurement no greater than those required of the reference method.

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 48-2, *Rubber, vulcanized or thermoplastic — Determination of hardness — Part 2: Hardness between 10 IRHD and 100 IRHD*

ISO 4007, *Personal protective equipment — Eye and face protection — Vocabulary*

ISO 18526-2:2020, *Eye and face protection — Test methods — Part 2: Physical optical properties*

ISO 18526-4, *Eye and face protection — Test methods — Part 4: Headforms*

ISO 18527-2, *Eye and face protection for sports use — Part 2: Requirements for eye protectors for Squash and eye protectors for Racquetball and Squash 57*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4007 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 <http://www.electropedia.org/>

4 Preparatory information

Before testing, refer to the product's requirement standard for the information needed to apply the tests in this document, for example:

- the number of test samples²⁾;

2) For the purpose of this document, "test sample" is taken to be the object under test, e.g. "lens", "filter", or "complete protector" as specified in the product's requirements standard.

- preparation of test samples;
- the selection of test samples (if included in this document);
- any prior conditioning or testing;
- test method (if more than one are included in this document);
- any deviations from the method(s);
- characteristics to be assessed subjectively (if appropriate);
- pass/fail criteria.

5 General test requirements

Unless otherwise specified, the values stated in this document are expressed as nominal values. Except for temperature limits, values that are not stated as maxima or minima shall be subject to a tolerance of $\pm 5\%$.

Unless otherwise specified, the ambient temperature for testing shall be between $16\text{ }^{\circ}\text{C}$ and $32\text{ }^{\circ}\text{C}$ but if any temperature limits are specified, these shall be subject to an accuracy of $\pm 2\text{ }^{\circ}\text{C}$. Relative humidity shall be maintained at $(50 \pm 20)\%$.

Unless otherwise specified, the test samples shall be tested at the reference points (for testing) as defined in ISO 4007.

The tests shall be performed by trained observers.

For each of the required measurements performed in accordance with this document, a corresponding estimate of the uncertainty of measurement shall be evaluated in accordance with [Annex A](#).

6 Physical test methods

6.1 Physical inspection

6.1.1 Principle

This test is intended to demonstrate that prior to applying any other test methods, the protector is free from visible defects or sharp edges.

6.1.2 Procedure

The test shall be carried out as follows:

- Inspect the mounting and surfaces of the lens of the complete test sample.
- Inspect all exposed surfaces of the protector for projections regarding sharp edges or other features that are likely to cause discomfort or injury to the wearer or interfere with vision.

6.1.3 Test report

Record surface and internal defects detected in the lenses and other components of the test sample that are likely to cause discomfort or injury to the wearer or interfere with the wearer's vision.

6.2 Field of view

6.2.1 Principle

This test is intended to demonstrate that the protector provides a minimum field of view for the wearer.

6.2.2 Apparatus

6.2.2.1 Headform, according to ISO 18526-4.

6.2.2.2 Goniometric device, to determine the rotation of the headform (6.2.2.1) in the horizontal and vertical planes.

NOTE A type A or type B goniometer can be used for purely horizontal or purely vertical measurements, see References [2] and [3].

6.2.2.3 CW-laser, emitting light in visible range, with beam diameter (2 ± 1) mm.

6.2.2.4 Detector, placed at the corneal vertex of the headform (6.2.2.1).

6.2.3 Procedure

The test shall be carried out as follows:

- Mount the test sample on the headform in accordance with the fitting information supplied by the manufacturer.
- Set the goniometric device to indicate 0° in the horizontal and vertical directions, with its axes of rotation passing through the right corneal vertex position of the headform. The angular setting of the goniometer shall be made with an uncertainty of measurement not exceeding 1° .
- Direct the laser beam so that it passes through the corneal vertex position of the right eye of the headform, along the horizontal line perpendicular to the facial plane of the headform.

NOTE Laser source and detector position are interchangeable.

- Rotate the headform to the left about the vertical axis to the position where the edge of the lens or the mounting prevents half of the laser beam from reaching the corneal vertex position. This is the temporal field of view. Record the angle to the nearest degree.
- Repeat by rotating the headform to the right to establish the nasal field of view.
- Return the headform to the 0° setting in the horizontal. Rotate the headform down to establish the superior field, and up for the inferior field.
- Repeat for the left eye.
- For a protector fitted with a single lens to cover both eyes, the field to the right should be measured as the temporal field for the right eye, the field to the left should be measured as the temporal field for the left eye; the superior and inferior fields may be measured for either eye.

6.2.4 Test report

Record the angular size of the temporal, nasal, superior and inferior fields of view of each lens of the test sample. For a single lens covering both eyes, record the right, left, superior and inferior fields of view.

6.3 Area to be protected — Assessment from the frontal direction

6.3.1 Principle

This test is intended to demonstrate that the protector satisfies the frontal protection requirement by showing that there is no direct path from the front to the area to be protected.

6.3.2 Apparatus

6.3.2.1 Headform, according to ISO 18526-4.

6.3.2.2 Steel rod, 2 mm nominal diameter, (125 ± 25) mm long with a flat, untapered, end.

6.3.3 Procedure

The test shall be carried out as follows:

- Mount the test sample on the specified headform (6.3.2.1) in accordance with the information to be supplied by the manufacturer, if provided.
- Mount the steel rod (6.3.2.2) horizontally and perpendicular to the line joining the corneal vertices.
- Probe to the limits of the area to be protected specified in the applicable product requirement standard, attempting to touch the surface of the headform.
- If the position of the test sample in front of the face of the headform is adjustable, carry out the assessment at the largest wearing distance for the specified headform.

6.3.4 Test report

Report whether or not the test sample prevents any portion of the end of the rod from touching the specified area to be protected on the headform.

6.4 Area to be protected — Assessment from the lateral direction

6.4.1 Principle

This test is intended to demonstrate that the protector satisfies the lateral protection requirement by showing that there is no direct path from the side to the area to be protected.

6.4.2 Apparatus

6.4.2.1 Headform, according to ISO 18526-4.

6.4.2.2 Steel rod, 2 mm nominal diameter, (125 ± 25) mm long with a flat, untapered, end.

6.4.3 Procedure

The test shall be carried out as follows:

- Mount the test sample on the headform (6.4.2.1) in accordance with the information to be supplied by the manufacturer, if provided.
- Mount the steel rod (6.4.2.2) horizontally and parallel to the line joining the corneal vertices.
- Repeat the procedure of 6.3.3 from the lateral direction on both sides of the test sample.

6.4.4 Test report

Report whether or not the test sample prevents any portion of the end of the rod from touching the specified area to be protected on the headform.

6.5 Retention by headbands and harnesses (sit and fit)

6.5.1 Principle

This test is intended to demonstrate that the protector fits comfortably and securely throughout a number of physical movements.

6.5.2 Procedure

The test shall be carried out as follows:

- The test sample shall be donned by two different trained observers and adjusted appropriately.
- When wearing the test sample, undertake the following accelerated movements, starting from a standing position:
 - turn head left and right;
 - tilt head back and forward;
 - standing jump on the spot five times.

6.5.3 Test report

Record any significant physical discomfort or insecurity of the fit of the test sample.

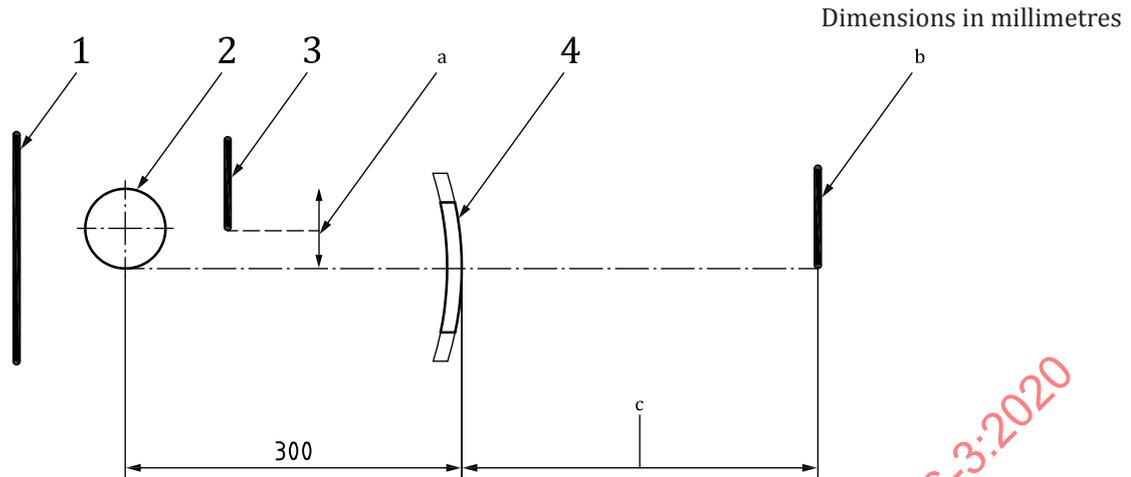
6.6 Visual assessment of material and surface quality of lenses

6.6.1 Principle

This test is intended to demonstrate that the material and surfaces of the lenses of a protector are free from visible defects.

6.6.2 Apparatus

A suitable apparatus is shown in [Figure 1](#).



Key

- | | | | |
|---|---|---|--------------------------------------|
| 1 | matt black background (150 mm × 360 mm) | a | Range of adjustment. |
| 2 | diffuse linear light source ≥400 lm | b | Plane of the trained observer's eye. |
| 3 | adjustable opaque shade or mask | c | Unobstructed vision, ≈400 mm. |
| 4 | movable test sample | | |

Figure 1 — Arrangement of apparatus for assessment of quality of material and surface

6.6.3 Procedure

The test shall be carried out as follows:

- Assess the quality of material and surfaces of the lens(es) of the test sample by visual inspection with the aid of an apparatus such as that in [Figure 1](#).
- Illuminate the lens by means of the diffuse linear light source and adjust the amount of illumination by means of the adjustable opaque black mask.
- Except for a marginal area 5 mm wide at the edge of the lens, record the presence of defects that would be likely to impair vision. Examples of defects include bubbles, scratches, inclusions, dull spots, striae, pitting, mould marks, scouring, grains, pocking, scaling and undulation.

NOTE An alternative method of inspection in current use consists of an illuminated grid as a background to be viewed through the lens which is held at various distances from the eye.

6.6.4 Test report

Record the presence of defects within the area to be inspected according to the product's requirement standard.

6.7 Resistance to thermal exposure

6.7.1 Principle

This test is intended to determine the ability of the components of the protector to resist deformation after exposure to high temperature in the environment.

6.7.2 Procedure

The test shall be carried out as follows:

- Place the complete test sample in an oven preheated to the specified temperature and maintain at this temperature for the prescribed time.
- Remove the test sample from the oven and immediately examine its components for indication of deformation.

6.7.3 Test report

Record any instances of deformation of components of the complete test sample.

6.8 Resistance to ultraviolet radiation

6.8.1 Principle

This test is intended to determine the ability of the lenses or filters to resist damage due to exposure to high intensity ultraviolet radiation. The test may be carried out for ultraviolet radiation from solar and/or artificial sources.

6.8.2 Solar ultraviolet radiation

6.8.2.1 Apparatus

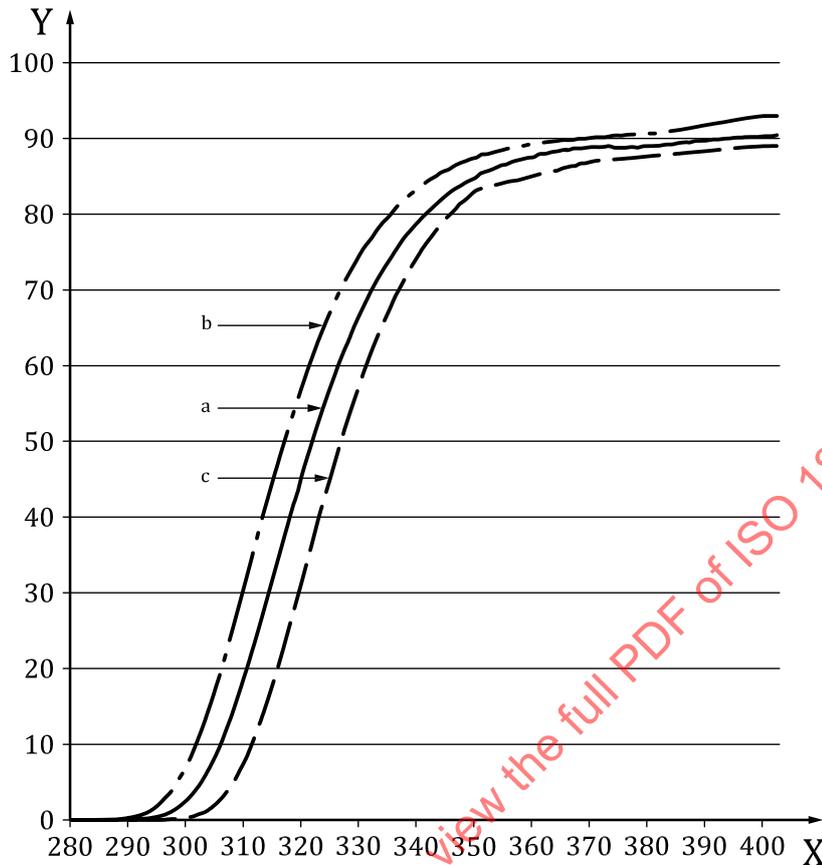
6.8.2.1.1 Fused-silica envelope high-pressure xenon lamp.

- The power of the lamp shall be between (450 ± 50) W.
- The spectral transmittance of the lamp envelope shall be at least 30 % at 200 nm.
- New lamps shall be burned in for at least 150 h.

The lamp shall not be used after 2 000 h of operation.

NOTE A suitable lamp reference is XBO-450 OFR.

6.8.2.1.2 **Long wavelength pass filter**, with the spectral transmittance shall be as defined in [Figure 2](#) and [Annex B](#), placed between the lamp and the test sample. A shift of ± 5 nm is permitted.



Key

- X wavelength, in nm
- Y spectral transmittance, in %
- a Nominal value.
- b Upper limit.
- c Lower limit.

NOTE The cut-on $\lambda_c = 320$ nm is defined as the wavelength at which $\tau_{\lambda,c} = 46$ %.

Figure 2 — Spectral transmittance of the long wavelength pass filter

6.8.2.2 Procedure

The test shall be carried out as follows:

- Stabilize the lamp current at $(25,0 \pm 0,2)$ A.
- The air temperature in the immediate area of the test sample shall be (28 ± 5) °C.
- Expose the front surface of the test sample to radiation from the lamp. The angle of incidence of the radiation on the test sample’s front surface shall be essentially perpendicular. The distance from the axis of the lamp to the nearest point on the test sample shall be (300 ± 10) mm. The exposure time shall be $(50,0 \pm 0,2)$ h at a lamp power of (450 ± 50) W unless otherwise specified in the requirements.

NOTE 1 It is deemed that the required irradiation will be fulfilled, without calibration or further verification, provided that the specified apparatus and test methods are applied.

NOTE 2 This test method can be used as a conditioning exposure for other test methods.

6.8.2.3 Test report

Record any damage that occurs.

6.8.3 Ultraviolet radiation from artificial sources

6.8.3.1 Apparatus

6.8.3.1.1 Fused-silica envelope high-pressure xenon lamp.

- The power of the lamp shall be between (450 ± 50) W.
- The spectral transmittance of the lamp envelope shall be at least 30 % at 200 nm.
- New lamps shall be burned in for at least 150 h.

The lamp shall not be used after 2 000 h of operation.

NOTE A suitable lamp reference is XBO-450 W/4.

- The lamp housing shall be vented to prevent exposure of the operator to ozone generated by the lamp.

6.8.3.2 Procedure

The test shall be carried out as follows:

- Stabilize the lamp current at $(25,0 \pm 0,2)$ A.
- The air temperature in the immediate area of the test sample shall not exceed (28 ± 5) °C.
- Expose the front surface of the test sample to radiation from the lamp. The angle of incidence of the radiation on the test sample's front surface shall be essentially perpendicular. The distance from the axis of the lamp to the nearest point on the test sample shall be (300 ± 10) mm. The exposure time shall be $(50,0 \pm 0,2)$ h at a lamp power of (450 ± 50) W unless otherwise specified in the requirements.

NOTE 1 It is deemed that the required irradiation will be fulfilled, without calibration or further verification, provided that the specified apparatus and test methods are applied.

NOTE 2 This test method can be used as a conditioning exposure for other test methods.

6.8.3.3 Test report

Record any damage that occurs.

6.9 Resistance to corrosion

6.9.1 Principle

This test is intended to determine the capability of metal components that are attached or fixed to any protector to resist corrosion. This test method does not apply to lenses (including those with metalized coatings) and electrical equipment, such as in automatic welding filters.

6.9.2 Reagents and materials

6.9.2.1 Boiling saline solution and saline solution at ambient temperature.

Both solutions shall be in containers of sufficient dimensions to submerge the metal parts. The saline solution shall contain 10 % by mass of technical or higher grade NaCl (sodium chloride) in deionised/distilled water.

6.9.3 Procedure

The test shall be carried out as follows:

- Using a clean dry cloth, clean the test sample's metal parts to remove all contamination, particularly oil and grease.
- Immerse the test sample for (15 ± 1) min in an aqueous boiling saline solution.
- Remove the test sample from the boiling saline solution and immediately immerse in the saline solution at ambient temperature for (15 ± 1) min.
- After removal from the saline solution at ambient temperature and without wiping off the adhering liquid, the test sample is allowed to dry for (24 ± 1) h at (23 ± 5) °C.
- The metal parts are then rinsed in lukewarm water and left to dry before inspection.

6.9.4 Test report

Report on whether metal parts of the test sample are functionally impaired by corrosion or if some metallic parts that might come in contact with the wearer's face in normal use show signs of corrosion.

6.10 Resistance to ignition

6.10.1 Principle

The test is intended to show that specified components of the protector resist ignition.

6.10.2 Apparatus

6.10.2.1 Steel rod, (300 ± 50) mm long and $(6,0 \pm 0,5)$ mm diameter with end faces that are flat and perpendicular to its longitudinal axis.

6.10.2.2 Heat source.

6.10.2.3 Thermocouple and temperature indicating device.

6.10.2.4 Timer, capable of measuring an elapsed time of 10,0 s with a resolution of $\pm 0,1$ s.

6.10.3 Procedure

All batteries and electronic parts likely to explode should not be subjected to testing.

The test shall be carried out as follows:

- Heat one end of the steel rod ([6.10.2.1](#)) over a length of at least 50 mm to a temperature of (650 ± 20) °C.

For routine testing, the steel rod may initially be heated in an oven/furnace to a greater temperature, e.g. around 900 °C. After removal, the temperature of the steel rod should be measured by means of the thermocouple ([6.10.2.3](#)) attached at a distance of (20 ± 1) mm from the heated end of the steel rod

which is allowed to cool to the required temperature to simulate a test. Then reheat the steel rod, again to the higher temperature, for a known time, remove the steel rod and repeat the cooling measurement. The time taken after removal of the steel rod from the oven for its temperature to fall to the required value should be recorded. Using these heating and cooling times avoids systematic measurement of the steel rod temperature during each contact with the test sample because the heating and cooling curve (temperature versus time) of the heated end of the steel rod is known.

- Press the heated face of the steel rod (long axis vertically) against the surface of the test sample (the contact force being equal to the weight of the steel rod) for a period of $(5,0 \pm 0,5)$ s, and then remove it.
- Carry out the test on all externally exposed parts of the protector.

6.10.4 Test report

Report whether or not each test sample ignites or continues to glow.

6.11 Resistance to fogging of lenses or filters

6.11.1 Principle

This test is intended to demonstrate that lenses are resistant to fogging.

6.11.2 Apparatus

Apparatus to determine the change in the direct transmittance value, as shown in [Figure 3](#).

6.11.2.1 Beam and beam splitter.

The nominal diameter of the parallel beam is 10 mm. The size of the beam splitter, reflector R and lens L_3 shall be selected so that reflected light is captured up to an angle of $0,75^\circ$. If a lens L_3 with a nominal focal length $f_3 = 400$ mm is used, the nominal diameter of the diaphragm is 10 mm. The plane of the diaphragm must lie in the focal plane of the lens L_3 .

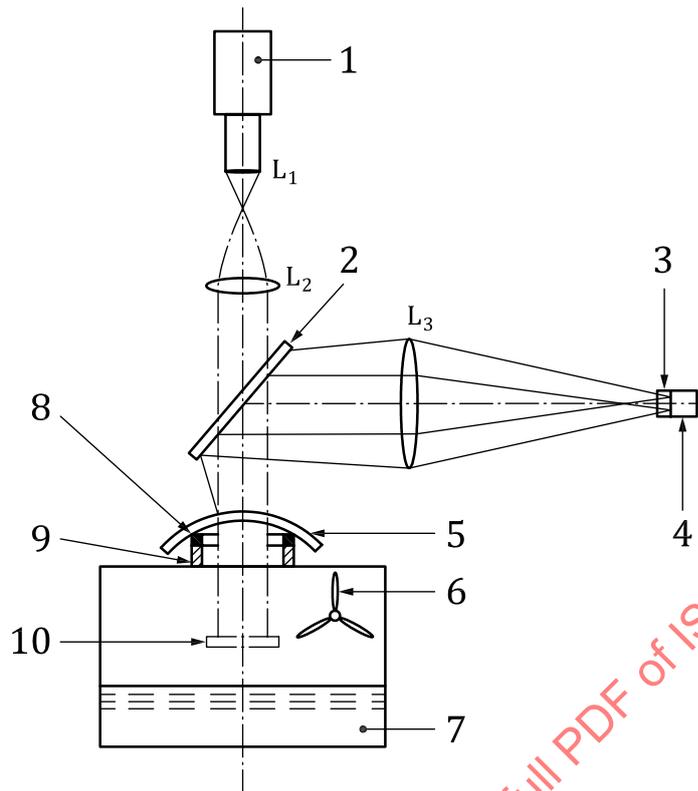
The focal lengths f_1 and f_2 ($f_1 = 10$ mm and $f_2 = 100$ mm) of the lenses L_1 and L_2 are nominal examples, and differing values will not affect the test results.

6.11.2.2 Light source, class 2 laser with a wavelength of (600 ± 70) nm.

6.11.2.3 Water bath.

The volume of air above the water bath is at least 4 l. The seating ring has a nominal diameter of 35 mm and a nominal height of 24 mm from the underside of the lid of the water bath. If the samples are cylindrically or toroidally curved, the curve on the top side of the seating ring is to be adjusted to fit the curve of the sample. The height of 24 mm is then measured to the highest point of the seating ring. A soft annular seal, 3 mm thick and 3 mm wide nominal dimensions, is inserted between the sample and the seating ring.

The water bath container also contains a fan to circulate the air. In addition, there shall also be a device to stabilise the temperature of the water bath.



Key

- | | | | |
|---|---------------|----|-------------------|
| 1 | laser | 6 | fan |
| 2 | beam splitter | 7 | water bath |
| 3 | diaphragm | 8 | soft annular seal |
| 4 | detector | 9 | seating ring |
| 5 | test sample | 10 | mirror |
| L | lens | | |

Figure 3 — Test apparatus for resistance to fogging

6.11.3 Conditioning

If the product requirements standard does not specify conditioning requirements for this test, the following procedure shall apply. Condition the test samples for (120 ± 5) min in distilled or deionised water (at least 5 cm^3 water per cm^2 sample surface area) at $(23 \pm 5) \text{ }^\circ\text{C}$. Dab dry and then condition in air for 12 h to 24 h at $(23 \pm 5) \text{ }^\circ\text{C}$ and $(50 \pm 20) \%$ relative humidity.

If the manufacturer specifies a cleaning procedure of the product prior to each use, this procedure shall be applied after the above conditioning.

6.11.4 Procedure

The test shall be carried out as follows:

- The ambient temperature during the measurement shall be $(23 \pm 5) \text{ }^\circ\text{C}$.
- The temperature of the water bath shall be $(50 \pm 0,5) \text{ }^\circ\text{C}$. The air above the water bath shall be circulated using a fan so that it becomes saturated with water vapour. During this time, the measurement opening shall be covered. The fan shall be switched off before measurement. The test sample shall be placed on the seating ring in the test position within 2 s of the opening being uncovered.

- To measure the "time before fogging", record the initial transmitted flux immediately after placing the test sample on the seating ring; then measure the time until the transmitted flux has dropped to (just less than) 80 % of the initial value. Initial fogging of maximum 0,5 s duration shall not be taken into consideration in the evaluation.

6.11.5 Test report

Report whether the requirement is met.

6.12 Protection against droplets

6.12.1 Principle

This test is intended to demonstrate that the protector prevents liquid droplets from reaching the eye.

6.12.2 Reagents, material and apparatus

6.12.2.1 Headform, according to ISO 18526-4.

6.12.2.2 Hand operated atomiser, producing fine droplets (not mist).

6.12.2.3 White non-fluorescent blotting paper, with a minimum water absorptivity of 0,02 g/cm², of sufficient size to protrude at least 20 mm all around the periphery of the test sample. The blotting paper is marked in pencil with two circles with diameter in accordance with [Table 1](#) at an interpupillary distance specified by the nominated headform in ISO 18526-4, within a tolerance of ±1 mm, corresponding to the ocular areas of the appropriate size of headform.

Table 1 — Nominal diameter of the circle and the PD on the blotting paper
(Tolerance on dimensions ±0,5 mm)

Dimensions in millimetres

Headforms	Type 1		Type 2	
	Circle diameter	PD	Circle diameter	PD
C6	36	52	—	—
C12	41	58	—	—
S	47	60	43	63
M	52	64	45	64
L	55	68	51	70

6.12.2.4 Detecting solution, prepared by dissolving (5,0 ± 0,5) g Thymol Blue sodium salt in (500 ± 50) ml ethanol and adding (500 ± 50) ml of water, stirring constantly (filter if a precipitate forms) to obtain (1,0 ± 0,1) l of solution.

6.12.2.5 Absorbent cotton lint (surgical dressing), mass per unit area approximately 185 g/m².

6.12.2.6 Spray solution, 0,1 mol/l solution of sodium carbonate in water.

6.12.3 Procedure

The test shall be carried out as follows:

- Cover the facial region of the headform ([6.12.2.1](#)) as defined in the applicable product's requirement standard with layers of cotton lint that is then covered with blotting paper that has previously been dipped in the detecting solution.

- Fit the test sample onto the headform in the normal wearing position and in accordance with the information to be supplied by the manufacturer, if provided, so that the blotting paper protrudes all around its periphery by at least 20 mm.
- Adjust the headband to a normal amount of tension.
- Adjust the number of layers of lint, as necessary, to ensure a good seal between the test sample and the headform.
- Spray the mounted test sample with the spray solution holding the atomiser at a distance of approximately 600 mm from the headform, spraying from all directions. Spraying is carried out with a volume of 5 ml to 10 ml of spray solution until the blotting paper around the periphery of the test sample turns a uniform blue colour. The blotting paper (6.12.2.3) shall not be over-wetted to cause it to drip.

6.12.4 Test report

Report whether the blotting paper shows a blue coloration within either of the two circles indicating that the spray solution has penetrated the protector.

6.13 Protection against streams of liquids

6.13.1 Principle

This test is intended to demonstrate that the protector prevents a high pressure liquid stream from reaching the eyes of the wearer. This would also confirm protection against splash.

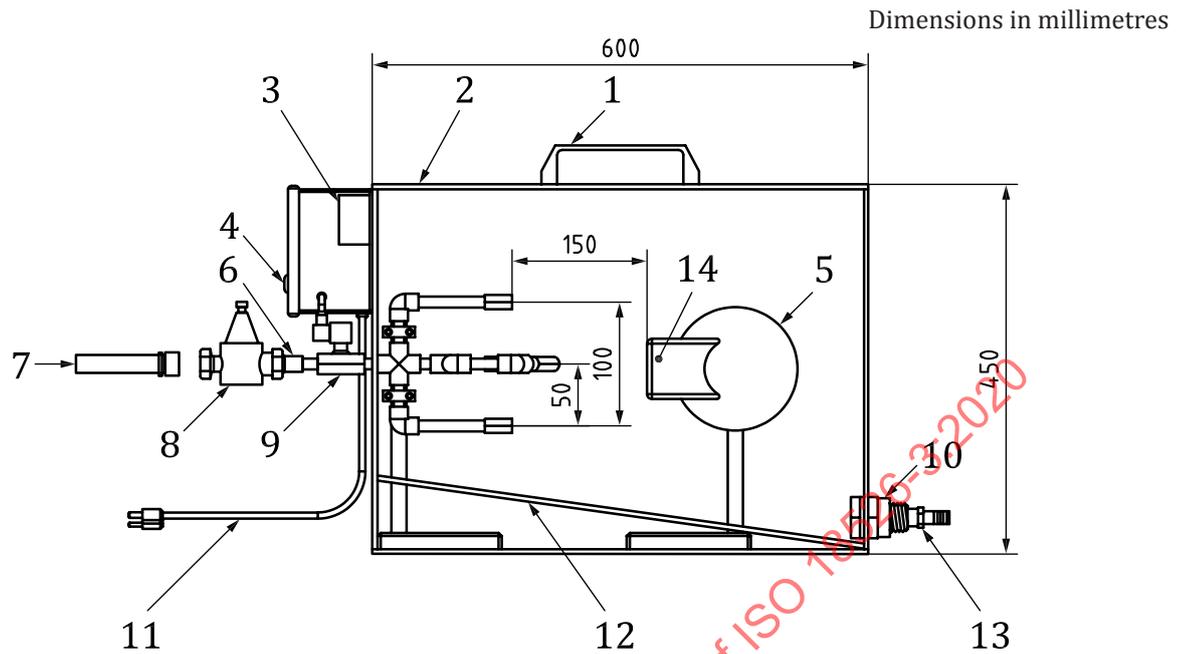
6.13.2 Reagents, materials and apparatus

6.13.2.1 Water supply.

6.13.2.2 **Headform:** according to ISO 18526-4.

6.13.2.3 **Spray apparatus** (see [Figure 4](#) and [Annex C](#)).

The spray apparatus shall be rigidly mounted with its major axis horizontal and at the height of the centre of the pupils of the headform (6.13.2.2). The minor axis shall be aligned with the vertical through the centre of the headform. The headform shall be adjustable such that the plane of the tips of the central nozzles of the spray apparatus can be positioned (150 ± 6) mm from the front surface of the lens of the protector.

**Key**

- | | | | |
|---|---|----|--|
| 1 | handle | 8 | pressure regulator |
| 2 | 6 mm thick clear acrylic box
(600 × 600 × 450 high) mm watertight
construction with removable cover | 9 | solenoid valve (normally closed) |
| 3 | surface mount timer relay single shot (0,5 to 10) s | 10 | through wall fitting |
| 4 | flush mount push button momentary contact | 11 | electrical power supply |
| 5 | headform | 12 | sloping floor for draining purposes
(to be removable) |
| 6 | water supply connector | 13 | drainage fitting |
| 7 | water supply to the system | 14 | protector |

Figure 4 — Side view of test apparatus of stream of liquids

6.13.3 Procedure

The test shall be carried out as follows:

- Fix the water-indicating blotting paper (6.12.2.3) to the facial region of the headform as defined in the applicable product's requirement standard.
- Mount the test sample on the headform as shown in Figure 4.
- Spray water onto the test sample for $(3,0 \pm 0,5)$ s at a pressure of (170 ± 10) kPa.
- Without removing the test sample, and within 15 s of the termination of the spray, inspect the blotting paper for water marks.

6.13.4 Test report

Report whether the blotting paper behind the test sample shows water marks.

6.14 Protection against large dust particles

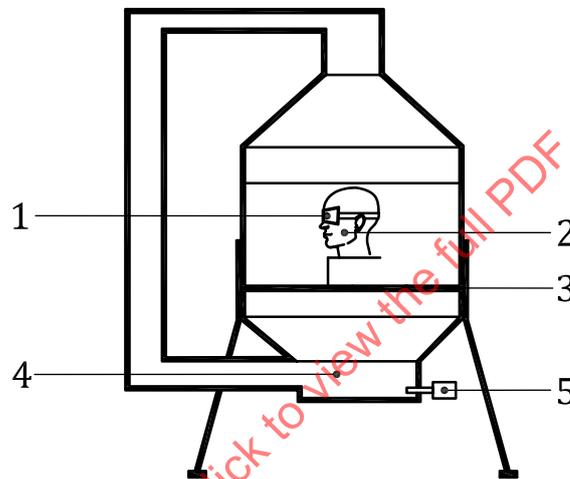
6.14.1 Test principle

This test is intended to demonstrate that the protector prevents large dust particles from reaching the eye area.

6.14.2 Material and apparatus

6.14.2.1 Dust-chamber (see [Figure 5](#)), glass fronted, with nominal internal dimensions (560 × 560 × 560) mm, with a hopper-shaped bottom and a tightly sealed, hinged lid.

A blower is connected to the bottom of the lower hopper capable of delivering approximately 2,8 m³/min of air at a pressure of 2 250 Pa in the upward direction. The dust-chamber outlet is connected to the blower inlet. The chamber is fitted with bars to support a headform, the spacing of the bars allows for free circulation of the dust within the chamber.



Key

- | | | | |
|---|-------------|---|----------------|
| 1 | test sample | 4 | dust collector |
| 2 | headform | 5 | blower |
| 3 | bars | | |

Figure 5 — Test apparatus for protection against large dust particles

6.14.2.2 Test dust, (1 000 ± 50) g of pulverized coal shall be placed inside the dust-chamber; the coal dust shall have a particle size not exceeding 0,3 mm.

6.14.2.3 Headform, according to ISO 18526-4 and as described in the product's requirement standard.

It shall be covered with layers of absorbent cotton lint (surgical dressing) of the approximate mass per unit area of 185 g/m². This lint shall be covered by a sheet of moist white blotting paper. The blotting paper is marked in pencil with two circles with diameter in accordance with [Table 1](#) at an interpupillary distance specified by the nominated headform in ISO 18526-4, within a tolerance of ±1 mm, corresponding to the ocular areas of the appropriate size of headform.

6.14.2.4 Photoelectric reflectometer, incorporating a light source radiating energy within the range (550 ± 50) nm and a detector sensitive only in the visible range, with peak sensitivity in the green part of the spectrum. An example of a suitable arrangement is shown in [Figure 6](#).

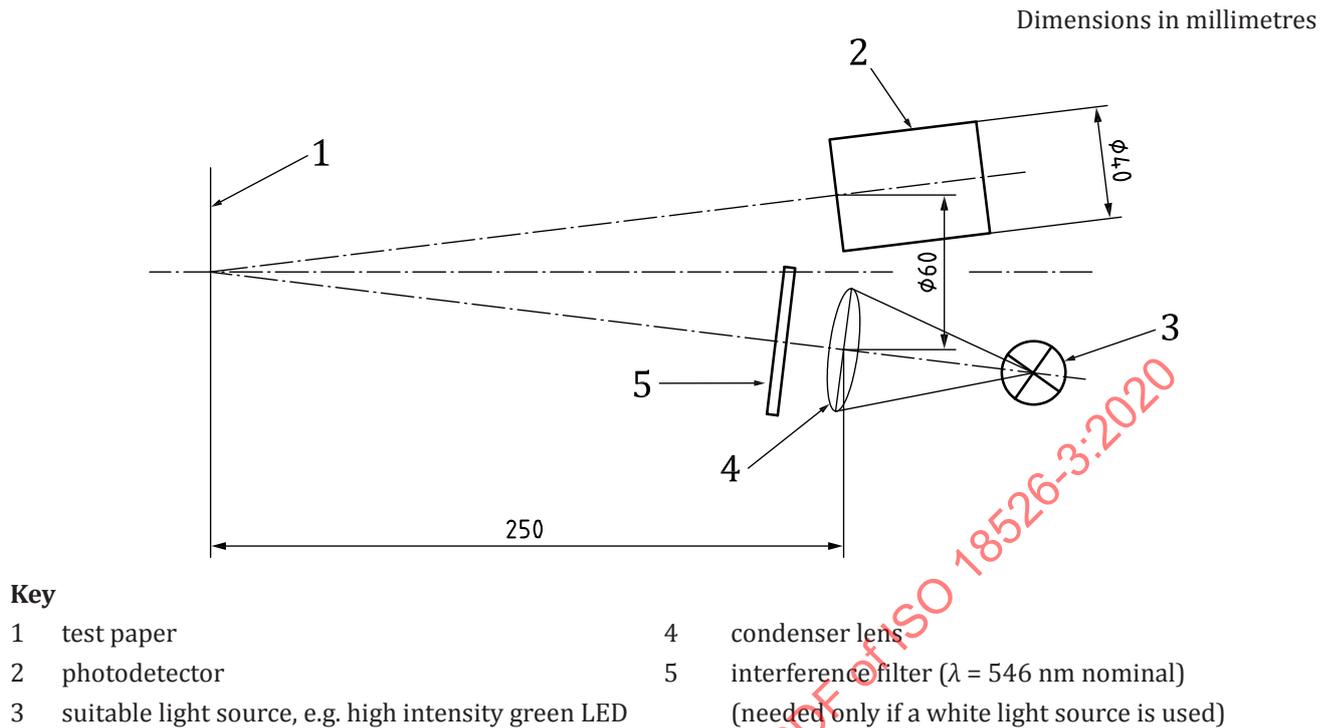


Figure 6 — Example of photoelectric reflectometer

6.14.2.5 White comparison sample, any white material capable of retaining a constant reflectance for the duration of the test, e.g. white opal glass, ceramic tile, pressing of barium sulfate, magnesium carbonate block, several thicknesses of clean, dry white paper.

6.14.2.6 Blotting paper, suitable blotting paper is one that has a minimum water absorptivity of $0,02 \text{ g/cm}^2$.

6.14.3 Procedure

The tests are conducted at an ambient temperature of $(23 \pm 5) \text{ }^\circ\text{C}$.

The test shall be carried out as follows:

- Soak the blotting paper (6.14.2.6) with water and then remove any excess by following one of the two methods below:
 - Squeezing the paper with a roller,
 - Hanging up the paper to drip for about 5 min.
- It is considered that there is no more excess of water when, if the paper is hanging up, no droplets fall within 60 s.
- Using the photoelectric reflectometer, measure the reflectance of each of the two circular areas on the wetted blotting paper relative to the white comparison sample and calculate the mean.
- Cover the headform with layers of absorbent cotton lint and then the sheet of moist blotting paper.
- Mount the test sample on the headform.
- Adjust the number of layers of cotton lint, as necessary, to ensure a good seal between the test sample and the headform.

- Place this assembly in the dust chamber.
- Mount a second piece of moist blotting paper, attached vertically on the headform or on any support near the headform.
- Operate the blower for (60 ± 2) s. Allow the dust chamber to remain undisturbed for (30 ± 2) min, then open it and remove the test sample and the blotting paper from the headform, being careful not to allow more dust to be deposited on the areas within the circles.
- Within 2 min, re-measure the reflectance of the two circular areas relative to the white comparison sample and again calculate the mean.
- Measure the reflectance of the second piece of moist blotting paper. A reflectance value of less than 30 % would indicate that sufficient coal dust was circulating during the test.

WARNING — Coal dust is extremely explosive when used in this manner. Before conducting this test, a risk assessment for explosion should be performed. There should be no open flames or sources of electrical spark in the test area and smoking should be prohibited.

6.14.4 Test report

Calculate the ratio of the mean reflectance after exposure in the dust chamber to the mean reflectance before exposure, express this ratio as a percentage and report whether the requirement has been met.

6.15 Protection against gases and fine dust

6.15.1 Principle

This test is intended to determine the capability of the protector to keep fine dust particles from reaching the wearer's eyes. This is not intended to evaluate the fit of the protector to the wearer's face.

6.15.2 Apparatus

6.15.2.1 Enclosed gas-tight chamber, with glass front and nominal dimensions of $(560 \times 560 \times 560)$ mm shall be used.

The gas-tight chamber shall be ventilated by means of a blower capable of delivering approximately $1,4 \text{ m}^3$ air/min and equipped with a vent pipe leading to a suitable gas removal/treatment system.

6.15.2.2 Detection/test area on the headform.

It shall be defined by white blotting paper with a minimum water absorptivity of $0,02 \text{ g/cm}^2$, of sufficient size to cover the ocular area and extend at least 20 mm beyond the periphery of the protector to be tested.

6.15.2.3 Absorbent cotton lint (surgical dressing), mass per unit area approximately 185 g/m^2 , is used to fit the protector more securely against the headform.

6.15.2.4 For the test, a supply of ammonia gas is connected to the gas chamber.

Suitable supplies include ammonia gas cylinders, or bubbling air through a wash bottle containing a concentrated (approximately $0,9 \text{ g/ml}$ water) solution of ammonia. The detection solution shall be prepared by dissolving $(5,0 \pm 0,5) \text{ g}$ phenolphthalein in $(500 \pm 50) \text{ ml}$ ethanol and adding $(500 \pm 50) \text{ ml}$ water, stirring constantly (filter if precipitate forms) to obtain $(1,0 \pm 0,1) \text{ l}$ of solution.

6.15.2.5 Headform, according to ISO 18526-4.

6.15.3 Procedure

The test shall be carried out as follows:

- Cover the headform with several layers of absorbent cotton lint (6.15.2.3).
- Dip the white blotting paper into the detection solution, shaking off any excess.
- Mount the moist paper over the lint, and then mount the test sample on the headform (6.15.2.5).
- Adjust the headband to a normal degree of tension. Adjust the number of layers of lint, as necessary, to ensure a good seal between the protector and the headform.
- Place a separate dose-indicating strip of blotting paper dipped in the detection solution on the floor of the chamber.
- Place the headform in the chamber.
- Open the chamber vent very slightly, then slowly introduce ammonia gas to fill the chamber. When the dose-indicating strip changes to a crimson colour, close the vent and leave the headform in the closed chamber for $(5,0 \pm 0,2)$ min. At the end of this time, evacuate the chamber thoroughly by operating the blower. After the chamber has cleared of ammonia, remove the headform.
- Examine the test blotting paper for coloration.

6.15.4 Test report

Report whether there is any coloration of the area covered by the test sample, except for a distance of not more than 6 mm inside the edge of the protector.

6.16 Protection against radiant heat

6.16.1 Principle

This test is intended to determine whether the protector will protect the wearer's face from radiant heat for a specified time. Damage to the protector indicates that the protector may not protect the wearer's eyes from the radiant heat. The test is based on studies of typical fire conditions.

6.16.2 Test apparatus

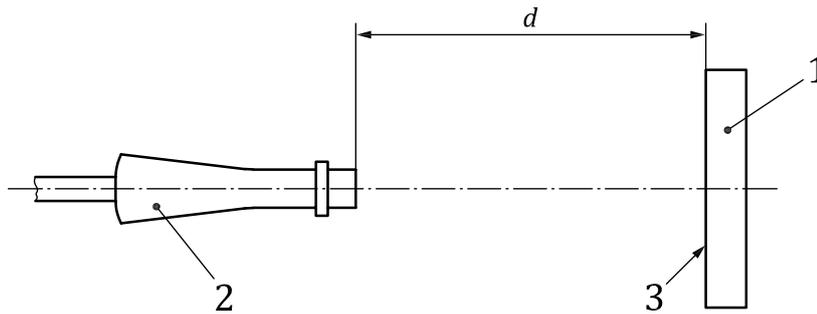
6.16.2.1 Headform, according to ISO 18526-4 made of solid non-metallic non-flammable heat resistant material.

6.16.2.2 Radiometer.

A calibrated radiometer is mounted with its sensing surface vertical facing the heat source. The radiometer shall have a peak spectral responsivity across the waveband between 1,5 μm and 3,5 μm .

NOTE 1 The radiometer needs to be located away from surfaces that can reflect radiant heat onto it or allow passage of measurable quantities of heat into the area around it.

NOTE 2 The effects of draughts are to be minimized.



Key

- 1 heat source
- 2 radiometer
- 3 radiating surface
- d* distance between the radiometer and the radiating surface

The radiometer is replaced by the test sample mounted on the headform in the as-worn position.

Figure 7 — Schematic for radiant heat test

6.16.2.3 Heat source.

A heater is mounted with its radiating surface vertical and facing towards the headform. The radiating surface shall be flat with dimensions (250 ± 5) mm by (250 ± 5) mm. The effective temperature of the emitted heat radiation shall be between 950 K and 1 450 K. The radiance of the source shall be uniform and shall be adjustable.

6.16.2.4 Radiometer detectors.

Two calibrated radiometer detectors (each preferably consisting of a thermocouple mounted on a circular copper disc of (7 ± 1) mm diameter) shall be secured by electrically insulating adhesive to the pupil positions of the headform.

6.16.2.5 Closed insulated chamber, of a size sufficient to contain the radiant panel and radiometer or headform with mounted test sample.

6.16.3 Preparation of the test sample

The test sample shall be conditioned at a temperature of (20 ± 3) °C and a relative humidity of 25 % to 50 % for at least 4 h. The test sample shall be tested within 5 min after removal from conditioning.

6.16.4 Procedure

Prior to testing, the internal environment of the chamber shall have a temperature of (20 ± 3) °C with a relative humidity of 25 % to 50 %.

The test shall be carried out as follows:

- Mount the conditioned test sample on the headform in the as-worn position, and place them in the insulated chamber. Measure the distance *d* from the radiating surface of the heat source to the exterior surface of the protector (see [Figure 7](#)).
- Record the temperatures at the corneal vertex positions of the headform, T_1 .
- Remove the headform to allow setting of the irradiance.

- Place the radiometer in the insulated chamber with its receiving sensor surface at the distance d , in the approximate position corresponding to the midpoint between the pupils of the headform and in the vertical plane parallel to the effective radiating surface of the heat source.
- Turn on the heat source and adjust by varying the power supply to produce a stable irradiance of $(10,0 \pm 0,1)$ kW/m² over a minimum 50 mm diameter circle centred on the sensor position. Stability shall be achieved when the irradiance changes by less than 0,5 kW/m² during a 3 min period.
- Upon achieving stability replace the radiometer with the headform and mounted test sample.
- Expose the test sample to the radiant heat $(10,0 \pm 0,1)$ kW/m² for the specified duration and then turn off the heat source. Immediately record the temperatures, T_2 at the corneal vertex positions of the headform at the end of the exposure time.

6.16.5 Test report

Report the difference between the temperatures measured (T_2 and T_1) as a result of the exposure. Also report whether any part of the protector shows damage (e.g. melting, softening or dripping of material).

6.17 Chemical resistance

6.17.1 Principle

This test is intended to demonstrate that protectors do not show changes in performance in mechanical, physical or optical tests following an exposure to the chemicals listed in the applicable product's requirement standard or chemicals specified by the manufacturer of the protector.

6.17.2 Procedure

Test chemicals shall be at ambient temperature. The assembly shall be tested with the test sample in the in-use position, oriented as though being worn by a standing subject.

The test shall be carried out as follows:

- Pour 100 ml of the test chemical onto the test sample and any exposed parts of the means of fixing or mounting. The chemical shall be poured along the upper exposed edges of the test sample assembly, moving from one side to the other using half the amount of chemical, and the rest going back, thus covering the assembly twice. This operation shall take (10 ± 3) s.
- 5 min after having applied the chemical, remove residues (using any appropriate method such as rinsing in clean water and drying).
- Carry out the mechanical and physical tests as specified in the applicable requirement standard.

6.17.3 Test report

Report whether the performance in the required tests has changed after exposure to the chemicals.

7 Mechanical test methods

7.1 General

[Table 2](#) summarizes the mechanical performance levels/tests that are specified in the various product requirement standards that relate to [7.2](#) and [7.3](#).

Table 2 — Summary of mechanical performance levels (7.2 and 7.3)

Sunglasses									
Category	Shape	Diameter mm	Force N	Method					
Minimum robustness	weighted ball	22	100	Static load					
Drop ball tests					Ballistics tests				
Category	Shape	Diameter mm	Mass g	Drop height m	Category	Shape	Diameter mm	Mass g	Velocity m/s
Strength Level 1	ball	16	16	1,27	Strength Level 3	ball	6	0,86	45
Strength Level 2	ball	22	43	1,27					
Occupational									
Category	Shape	Diameter mm	Mass g	Drop height m	Category	Shape	Diameter mm	Mass g	Velocity m/s
Basic Impact	ball	25,4	66,8	1,27	Impact level C	ball	6	0,86	45
					Impact level D	ball	6	0,86	80
High Mass	cone		500	1,27	Impact level E	ball	6	0,86	120
Welding filters									
Category	Shape	Diameter mm	Force N	Method					
Minimum robustness	weighted ball	22	100	Static load					
Sports									
Category	Shape	Diameter mm	Mass g	Drop height m	Category	Shape	Diameter mm	Mass g	Velocity m/s
Strength Level 2	ball	22	43	1,27	Squash	yellow dot ball	40,0	24,0	40
High Mass	cone		500	1,27	Racquetball and Squash 57	ball	57,3	39,2	40
NOTE All quantities in this table are nominal. See the applicable product requirement standard for the specified tolerances.									

7.2 Tests on unmounted lenses

7.2.1 Minimum robustness of unmounted lenses (static load test)

7.2.1.1 Principle

This test is intended to demonstrate that the test sample does not fracture when a static load (100 ± 2) N is applied on its front surface.

7.2.1.2 Apparatus

7.2.1.2.1 Steel ball ([Figure 8](#)), of 22 mm nominal diameter is fastened to the lower end of a tube of 70 mm nominal length. The tube carries a loading mass so that the force applied to the test sample is (100 ± 2) N.

7.2.1.2.2 Specimen support and elastomer supporting rings, consisting of a steel supporting plate and a pressure ring. The upper surface of the steel supporting plate and the lower surface of the pressure ring are, by appropriate means, each fitted with a circular silicone rubber ring of (40 ± 5) IRHD having an inside diameter of $(35,0 \pm 0,1)$ mm and a nominal cross section of (3×3) mm.

7.2.1.2.3 Adaptor sleeves.

They shall be used if the test sample is of insufficient dimensions to enable its entire periphery to be adequately supported.

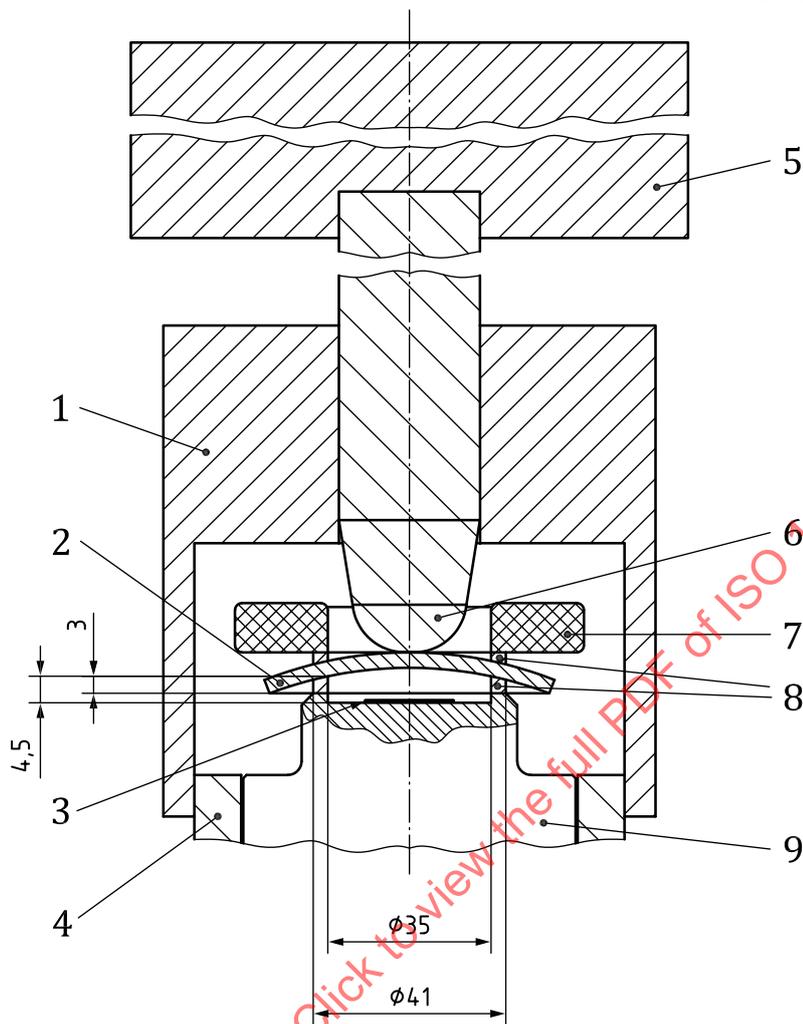
7.2.1.2.4 Pressure ring, with a mass of (250 ± 5) g.

By its weight, it presses the elastomer supporting ring against the upper surface of the test sample.

7.2.1.2.5 Contact indicating material, placed on the supporting steel plate at the base of the 1,5 mm deep cavity.

NOTE Acceptable contact indicating material can include carbon paper and white paper affixed to the supporting steel plate or a thin layer of contact paste or similar material of thickness less than 0,5 mm.

Dimensions in millimetres



Key

- | | | | |
|---|--|---|----------------------------|
| 1 | guiding block | 5 | loading mass |
| 2 | test sample (can be curved) | 6 | steel ball |
| 3 | carbon paper on white paper or similar contact indicating material | 7 | pressure ring |
| 4 | centring ring | 8 | elastomer supporting rings |
| | | 9 | steel base |

Figure 8 — Apparatus for minimum robustness (static load deformation) test

7.2.1.3 Procedure

The test shall be carried out as follows:

- Align the central vertical axis of the loading tube with that of the test sample support.
- Position the test sample on the supporting ring with the back surface downwards and place the pressure ring on the test sample. For curved lenses with both surfaces being cylindrical or toroidal, the top surface of the steel base may be curved to conform to the surface of the test sample and the supporting ring may be flexed to match. The dimensions of 3,0 mm and 4,5 mm shall apply to the vertical distance between the lowest point of the test sample resting on the supporting ring and the steel supporting plate and the top surface of the contact indicating material respectively.

- Adjust the position of the test sample such that the pressure ring axis passes through the boxed centre of the test sample.
- Lower the loading mass onto the test sample at a velocity not exceeding 400 mm/min. The force of (100 ± 2) N is maintained for (10 ± 2) s.
- Then remove the loading mass.

7.2.1.4 Test report

Record whether the test sample has fractured and/or the contact indicating material has been disturbed.

7.2.2 Drop ball test for unmounted lenses

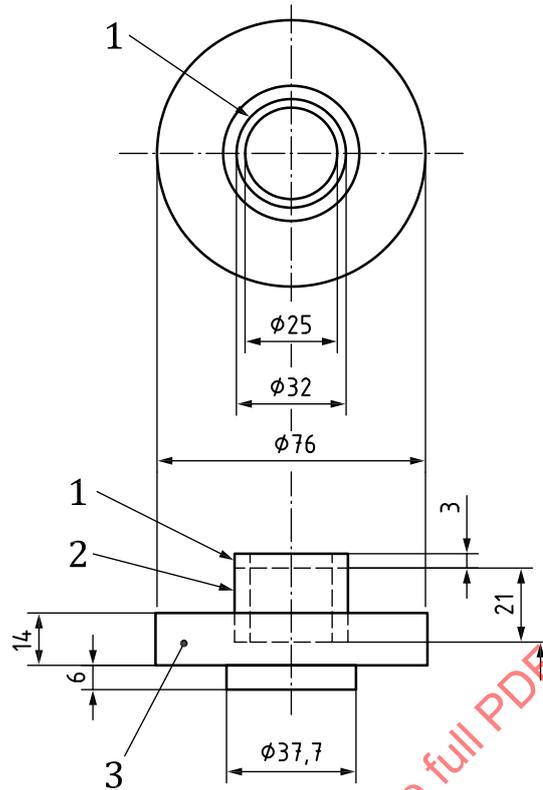
7.2.2.1 Principle

This test is intended to show resistance to breakage when a steel ball with a specified nominal diameter is allowed to fall a specified distance onto the lens, which is supported on a rigid base.

7.2.2.2 Apparatus

7.2.2.2.1 Support tube and test block (see [Figure 9](#)).

The test block shall be made of steel and is applicable to the majority of lenses. However, if a diameter of the lens is less than 32,0 mm, a substitute support may be used whose outside diameter is equal to or less than the smallest diameter of the lens.



Key

- 1 elastomer gasket
- 2 support tube
- 3 test block

NOTE 1 Modification of the support tube can be made to accommodate test sample surfaces with non-spherical surfaces.

NOTE 2 The test block is to be inserted in the baseplate described in [Figure 10](#).

Figure 9 — Support tube and test block for drop ball test

7.2.2.2.2 Elastomer gasket, with a hardness of (40 ± 5) IRHD, as determined by ISO 48-2.

It shall be securely bonded to the support tube which shall be made of a rigid material. Modification of the support tube may be made to accommodate non-spherical lens surfaces. The nominal thickness of the elastomer gasket is 3,2 mm.

7.2.2.2.3 Baseplate ([Figure 10](#)), made of steel.

7.2.2.2.4 Steel ball.

The diameter and weight of the steel ball, and the drop height shall be taken from the applicable product's requirement standard. See also [Table 2](#).

Dimensions in millimetres

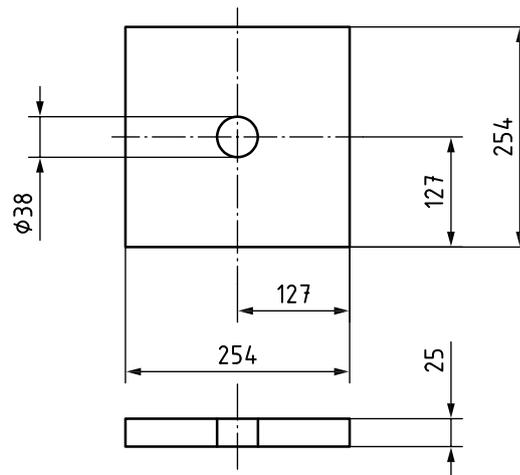


Figure 10 — Baseplate for drop ball apparatus

7.2.2.3 Procedure

The test shall be carried out as follows:

- Condition the test sample thermally at the required temperature for at least 1 h. Apply the impact within 60 s of temperature conditioning.
- Test the test sample with its front surface uppermost and supported by the support tube described in [7.2.2.2.1](#).
- Drop a steel ball, of specified diameter and weight, in free fall from the specified height onto the front surface of the test sample. The ball shall strike within a 16 mm diameter circle centred on the boxed centre of the test sample. The ball can be guided, but not restricted, in its fall by being dropped through a tube extending to within approximately 100 mm of the test sample.

7.2.2.4 Test report

Report whether lens fracture occurs.

7.3 Tests on complete eye protectors

7.3.1 Drop ball test for complete protectors

7.3.1.1 Principle

This test is intended to show resistance to breakage when a steel ball with a specified nominal diameter is allowed to fall a specified distance onto the lens of the complete protector, which is supported on a massive base.

7.3.1.2 Apparatus

7.3.1.2.1 Headform, according to ISO 18526-4 mounted horizontally, face up, as well as positions defined in the applicable requirement standard. The headform shall have a surface with a hardness of (50 ± 5) IRHD as determined in ISO 48-2.

7.3.1.2.2 Steel ball, with a diameter, a weight and the drop height taken from the applicable product's requirement standard. See also [Table 2](#).

7.3.1.2.3 Guide tube, from the drop ball test apparatus as described in [7.2.2.3](#).

7.3.1.3 Procedure

The test shall be carried out as follows:

- Condition the test sample thermally at the required temperature for at least 1 h. The impact shall be applied within 60 s of temperature conditioning.
- Mount the test sample onto a suitably sized headform and adjust for a secure fit in accordance with the information supplied by the manufacturer, if provided.
- Drop a steel ball, of specified diameter and weight, in free fall from the specified height onto the outer surface of the test sample. The ball shall strike within a 16 mm diameter circle centred on the intended point. The ball may be guided, but not restricted, in its fall by being dropped through a tube extending to within approximately 100 mm of the test sample.

7.3.1.4 Test report

Report whether lens fracture, lens housing or frame fracture, lateral protection failure, and/or displacement of the protector occurs.

7.3.2 Ballistic impact test for complete protectors

7.3.2.1 Normal ambient temperatures

7.3.2.1.1 Principle

This test is intended to demonstrate that the protector resists the impact of a ball moving at speed.

7.3.2.1.2 Apparatus

7.3.2.1.2.1 Headform, according to ISO 18526-4.

The headform shall have a surface with a hardness of (50 ± 5) IRHD as determined in ISO 48-2.

7.3.2.1.2.2 Propulsion apparatus.

It shall be capable of imparting known velocities of up to 120 m/s to a steel ball of 0,86 g minimum mass and 6 mm nominal diameter. For testing of sports eye protectors, the apparatus shall be capable of imparting known velocities of up to $(40,0 \pm 0,5)$ m/s to a projectile such as a squash ball or racquetball ball as specified in ISO 18527-2.

NOTE 1 The apparatus typically consists of a barrel or tube of sufficient length to ensure a reproducible exit velocity of the ball, with a breech or loading mechanism ensuring that the ball is in a given position in relation to the tube or barrel end, and of a spring or compressed gas to provide propulsion.

NOTE 2 The tube length is chosen to ensure that the required velocity for the ball is achieved.

The end of the barrel or tube should be protected against ricochets. The apparatus also includes a means of calibrating or measuring the exit velocity of the ball; because of the velocity and distances involved, a timing indicator, recording in multiples of not greater than 10 μ s is required. The measurement of velocity should be made as near as possible to the point of impact. The distance between the sensing elements should not exceed 150 mm.

NOTE 3 For the time measurement, a method using an electronic timer operated by photoelectric cells through amplifiers has been found suitable.

The area surrounding the test sample, the headform and the barrel or tube should be enclosed.

7.3.2.1.3 Procedure

The test shall be carried out as follows:

- Place contact indicating material on the headform at the location specified by the applicable product requirement standard.

NOTE Acceptable contact indicating material can include carbon paper and white paper affixed to the headform surface, or a thin layer of contact paste or similar material of thickness less than 0,5 mm.

- Place the test sample on the headform in the position corresponding to normal use (the as-worn position) and with the tension of the headband, if fitted, adjusted according to the information to be supplied by the manufacturer.
- Position the test sample/headform assembly in front of the propulsion equipment, the point of impact being not more than 250 mm from the exit end of the velocity sensing equipment.
- Project the specified ball at the velocity specified in the applicable product's requirement standard at the points of impact specified. The ambient temperature shall be (23 ± 5) °C.

7.3.2.1.4 Test report

Report whether lens fracture or deformation, lens housing or frame failure, and/or lateral protection failure occurs, or whether the contact indicating material has been disturbed, indicating that the test sample made contact with the area to be protected.

7.3.2.2 Extremes of temperature

7.3.2.2.1 Procedure

The test shall be carried out as in [7.3.2.1.3](#) but with the impacts carried out under the following conditions:

- a) with the test sample heated to (55 ± 2) °C and maintained at this temperature for at least 1 h;
- b) with the test sample cooled to a temperature of (-5 ± 2) °C and maintained at this temperature for at least 1 h.

If other extreme temperatures are specified by the applicable product's requirement standard, or claimed by the manufacturer, these shall be substituted here.

The impact shall be applied within 30 s of removal from temperature conditioning.

7.3.2.2.2 Test report

Report whether lens fracture, penetration, dislodgement or contact with the area to be protected occurs for each conditioning temperature.

7.3.3 High mass test for complete protectors

7.3.3.1 Normal ambient temperatures

7.3.3.1.1 Principle

This test is intended to demonstrate that a protector resists the impact of a high-mass projectile moving at moderate velocity at (23 ± 5) °C.

7.3.3.1.2 Apparatus

7.3.3.1.2.1 Headform, according to ISO 18526-4, mounted horizontally, face up. Place contact indicating material on the headform at the location specified by the applicable product requirement standard. The headform shall have a surface with a hardness of (50 ± 5) IRHD as determined in ISO 48-2.

NOTE Acceptable contact indicating material can include carbon paper and white paper affixed to the headform surface, or a thin layer of contact paste or similar material of thickness less than 0,5 mm.

7.3.3.1.2.2 Steel projectile, having a conical tip as specified in the product's requirement standard. The projectile may have a hardened steel tip. Care shall be taken to maintain the tip configuration and weight of the missile.

7.3.3.1.3 Procedure

The test shall be carried out as follows:

- Place the test sample on the headform in the position corresponding to normal use and with the tension of the headband, if fitted, adjusted according to the information supplied by the manufacturer.
- The steel projectile shall be held in position over the headform, tip down, at the specified test height. The missile may be guided, but not restricted, in its fall by being dropped through a tube extending to within approximately 180 mm of the test sample.

A new test sample shall be used for each individual impact and for each temperature condition.

7.3.3.1.4 Test report

Report whether lens fracture, penetration or dislodgement occurs, or whether the contact indicating material has been disturbed, indicating that the test sample made contact with the area to be protected.

7.3.3.2 Extremes of temperature

7.3.3.2.1 Procedure

The test shall be carried out as in [7.3.3.1.3](#) but with the impacts carried out under the following conditions:

- a) with the test sample heated to a temperature of $(55 + 2)$ °C and maintained at this temperature for at least 1 h;
- b) with the test sample cooled to a temperature of $(-5 + 2)$ °C and maintained at this temperature for at least 1 h;

Where a more extreme temperature is specified by the manufacturer, the appropriate temperature with an accuracy of ± 2 °C shall be substituted for the relevant test condition.

The impact shall be applied within 30 s of removal from temperature conditioning.

7.3.3.2.2 Test report

Report whether lens fracture, penetration or dislodgement occurs, or whether the contact indicating material has been disturbed, indicating that the test sample made contact with the area to be protected.

7.4 Resistance to surface damage due to flying fine particles

7.4.1 Principle

This test is intended to show that the lens surface of a protector resists abrasion by flying fine particles. The results of this test shall not be used to rank order the performance of various lens materials or surface treatments.

7.4.2 Material and apparatus

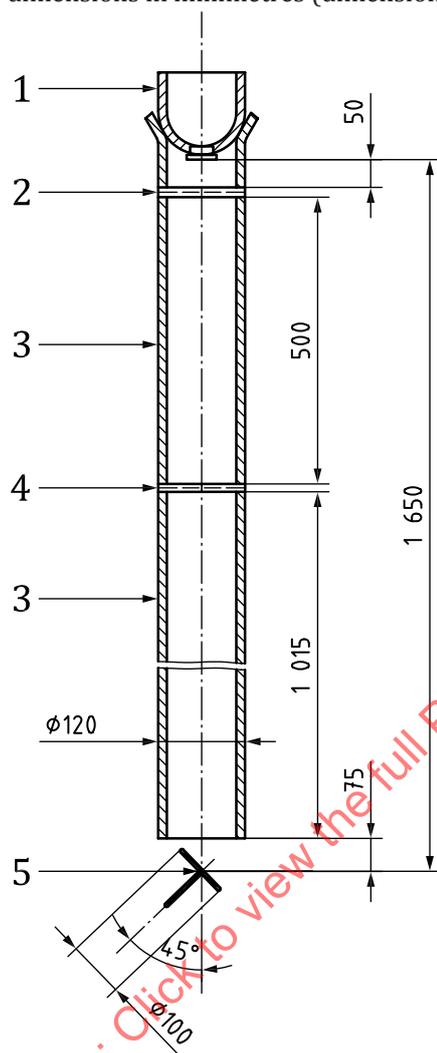
7.4.2.1 Falling sand apparatus, as shown in [Figures 11](#) and [12](#).

The gravity tube is made from three separate rigid PVC tubes of the same diameter, with two polyamide sieves inserted between them. The sieves have a mesh size of 1,6 mm. The velocity of rotation of the plate is (250 ± 10) r/min.

NOTE It is recommended that the motor that drives the rotating sample holder is provided with a suitable casing to prevent the ingress of sand.

7.4.2.2 Natural quartz sand, grain size of 0,5 mm to 0,7 mm, without oversize, obtained by sieving onto the wire sieve floor in accordance with ISO 565 'test sieves' R 20/3 with a mesh size 0,50 mm and 0,71 mm. The sand may be used for up to 10 tests.

Linear dimensions in millimetres (dimensions nominal unless tolerances indicated)



Key

- 1 container to hold at least 3 kg of sand with an outlet nozzle as [Figure 12](#)
- 2 upper sieve
- 3 gravity tube component
- 4 lower sieve
- 5 sample holder (rotating plate connected to electric motor)

Figure 11 — Falling sand test apparatus

Dimensions in millimetres

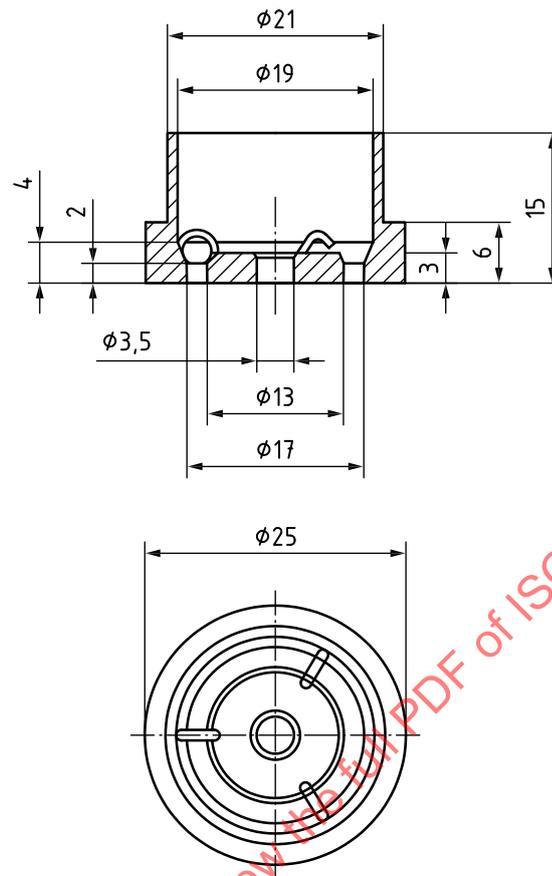


Figure 12 — Outlet nozzle for falling sand apparatus (manufactured from brass with perforated plates held centrally by three connecting pieces)

7.4.3 Preparation of reference samples for measurement of light scatter

7.4.3.1 Reference samples

Two reference samples approximately 40 mm in diameter or 40 mm square made from materials for which the increase in light scatter caused by the surface damage test is known. Suitable materials for reference samples are B270³⁾ drawn crown glass with natural fire-polished surfaces and cast PMMA.

7.4.3.2 Reference values for narrow angle light scatter

The reference value of B270 = $(3,0 \pm 0,3)$ cd/(m²lx).

The reference value of PMMA = (23 ± 2) cd/(m²lx).

7.4.3.3 Reference values for wide angle light scatter

The reference value of B270 = $(4,5 \pm 0,4)$ %.

The reference value of PMMA = (29 ± 2) %.

3) Schott B270 is the trade name of a product supplied by SCHOTT. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.

7.4.4 Preparation of test samples

The shape of the test samples shall be selected such that the measuring areas of the test samples do not project beyond the revolving plate. Depending on the size of the samples, up to 4 samples of 40 mm diameter may be fixed on the revolving plate. Two of these samples should be reference samples.

The test samples may be flat or convex, and of different thicknesses.

The surfaces of the test samples shall be cleaned with a solution of (1,0 ± 0,2) % detergent in water at a temperature of (27 ± 3) °C. Cleaning liquid residues shall be rinsed off firstly under running water and then with distilled or deionised water. The samples shall then be carefully dried with a cloth that is free from dust and grease.

After cleaning, the samples shall only be held by the edges and shall be stored in such a way that their surfaces are not damaged or soiled.

7.4.5 Procedure

The test shall be carried out as follows:

- Weigh (3,00 ± 0,01) kg sand and load it into the test apparatus.
- Fix the test samples onto the revolving plate in such a way that the area of measurement does not project beyond the revolving plate.
- While the plate is being rotated, trickle the sand onto the test samples.
- After the sand has been trickled onto them, remove the test samples from the revolving plate and clean the test samples as described in 7.4.4.

Either the wide or narrow angle scatter of the samples shall be measured as described in ISO 18526-2:2020, 14.1 and 14.2 respectively, as specified by the applicable product's requirement standard.

7.4.6 Evaluation of narrow angle scatter of the test sample

When specified by the applicable product requirement standard, the narrow angle scatter of the test sample shall be evaluated as follows.

The reduced luminance coefficient l^* of the sample is obtained using the following [Formula \(1\)](#):

$$l^* = l_{mv}^* \frac{(l_1^* - l_{mv}^*) \frac{23}{l_1^*} + (l_{mv}^* - l_2^*) \frac{3}{l_1^*}}{(l_1^* - l_2^*)} \tag{1}$$

where

- l_1^* is the measured value of the B270 sample;
- l_2^* is the measured value of the PMMA sample;
- l_{mv}^* is the measured value of the sample under test.

NOTE The simultaneous testing of two reference samples and adjustment to their known results is intended to eliminate the effect of different sand qualities.

7.4.7 Evaluation of wide angle scatter of the test sample

When specified by the applicable product requirement standard, the wide angle scatter of the test samples shall be evaluated according to ISO 18526-2.

Calculate the wide angle scatter, w , of the sample using [Formula \(2\)](#):

$$w = l_{mv}^* \frac{(l_3^* - l_{mv}^*) \frac{29}{l_4^*} + (l_{mv}^* - l_4^*) \frac{4,5}{l_3^*}}{(l_3^* - l_4^*)} \quad (2)$$

where

l_3^* is the measured value of the B270 sample;

l_4^* is the measured value of the PMMA sample;

l_{mv}^* is the measured value of the sample under test as a percentage.

NOTE The simultaneous testing of two reference samples and adjustment to their known results is intended to eliminate the effect of different sand qualities.

7.4.8 Test report

Record the measured values of reduced luminance coefficient or the amount of wide angle scatter of the test samples, as specified.

7.5 Penetration of vents and gaps

7.5.1 Principle

This test is intended to demonstrate that eye protectors with ventilation openings or gaps between components (front and lateral protection) shall not have a direct pathway to the area to be protected through the vents or gaps.

7.5.2 Apparatus

7.5.2.1 **Headform**, according to ISO 18526-4.

7.5.2.2 **Rod**, with a diameter D_p of $(1,5^{+0,02}_0)$ mm and rounded tip of radius R (see [Figure 13](#)).

7.6.1.2.3 Metal seating ring, fixed to the stop platform (7.6.1.2.2) and incorporating a central opening of 75 mm nominal diameter to allow the charge of metal to pass through. The seating ring supports the test sample.

7.6.1.2.4 Metal cylindrical clamping ring, with opening of 75 mm nominal diameter, combined, if necessary, with an additional clamping weight to give a total nominal clamping mass of 7,5 kg.

NOTE If necessary, the surfaces of the seating ring and clamping ring are to be curved to conform to the test sample.

7.6.1.2.5 Ceramic crucible, of approximately 60 ml capacity, 40 mm nominal depth, 2 mm nominal thickness and 58 mm nominal lip diameter.

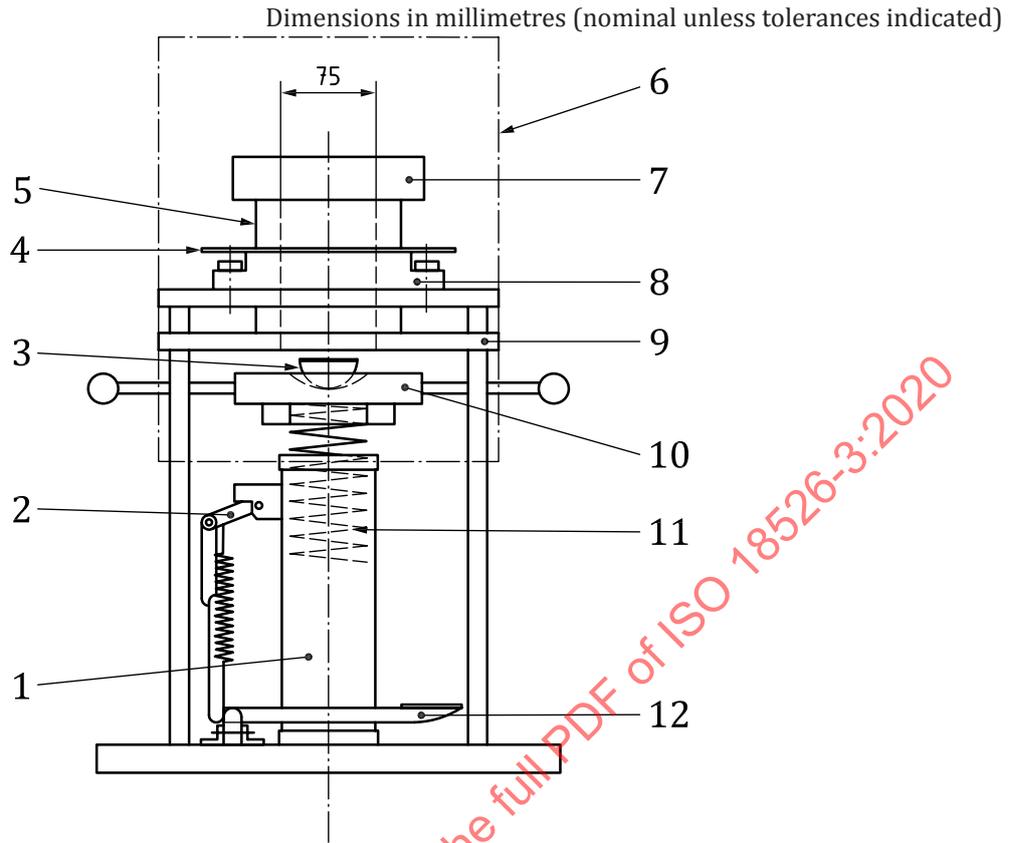
NOTE When ejected, the crucible and its contents are projected onto the test sample.

7.6.1.2.6 Grey iron, with a mass of (100 ± 5) g.

7.6.1.2.7 Aluminium, with a mass of (38 ± 2) g.

7.6.1.2.8 Protective housing, enclosing the whole assembly to ensure safe operation.

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Key

- | | | | |
|---|------------------------|----|--------------------|
| 1 | ejector cylinder | 7 | clamping weight |
| 2 | spring release trigger | 8 | metal seating ring |
| 3 | crucible | 9 | stop platform |
| 4 | test sample | 10 | ejector head |
| 5 | clamping ring | 11 | ejector spring |
| 6 | protective housing | 12 | release pedal |

Figure 14 — Example of one type of apparatus for assessment of non-adherence of molten metal

7.6.1.3 Procedure

The test shall be carried out as follows:

- Mount the test sample above the opening so that the area being tested is immediately above the centre of the ejector head.
- Secure the test sample with the clamping ring weight, or rubber/elastic straps; load the ejector head with a ceramic crucible (7.6.1.2.5) containing (100 ± 5) g of grey iron (7.6.1.2.6) at a temperature of $(1\ 450 \pm 20)$ °C.
- Release the catch, so that the ejector head is driven vertically upwards until it strikes the stop platform and ejects the crucible of molten metal on to the test sample.
- Remove the test sample and examine it to see if any molten metal has adhered to any part of it.
- Repeat the test using a second ejector head and using (38 ± 2) g of aluminium (7.6.1.2.7) at (750 ± 20) °C.

7.6.1.4 Test report

Report if any molten metal has adhered to any part of the test sample.

7.6.2 Resistance to penetration of protector by hot solids

7.6.2.1 Principle

This test is intended to demonstrate that the components of the protector resist penetration by a hot solid object.

7.6.2.2 Apparatus

The apparatus shall consist of the following (see also [Figure 15](#)).

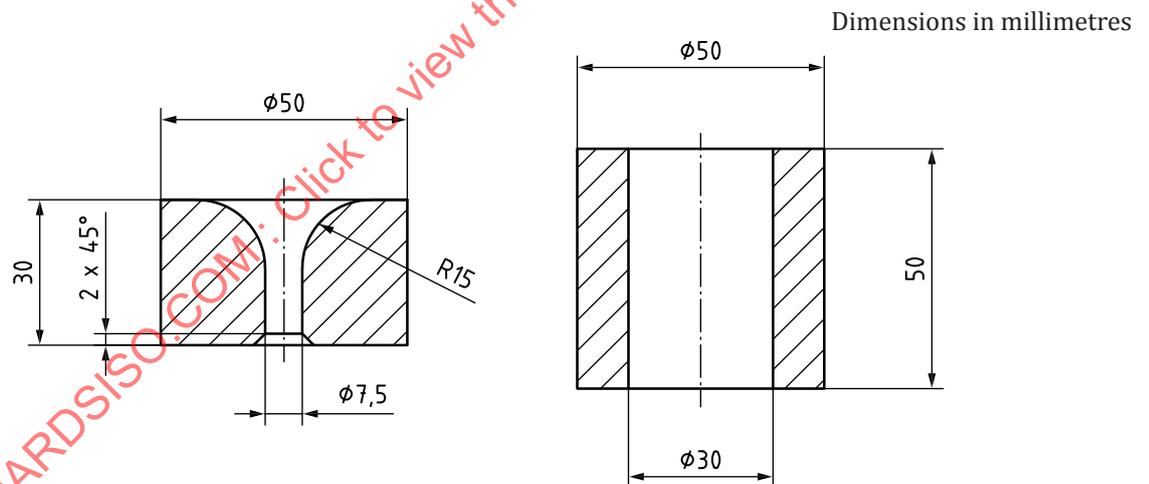
7.6.2.2.1 **Metal cylinder**, to support the test sample.

7.6.2.2.2 **Funnel of heat insulating material**, to centre a steel ball on the test sample.

7.6.2.2.3 **Steel ball**, of 6 mm nominal diameter.

7.6.2.2.4 **Heat source**, capable of maintaining the steel ball at a temperature of $(900 \pm 20) ^\circ\text{C}$.

7.6.2.2.5 **Timer**, capable of measuring an elapsed time with an uncertainty of measurement of $\pm 0,1$ s.



Key

R radius of curvature of surface of funnel

Figure 15 — Apparatus for testing resistance to penetration by hot solids

7.6.2.3 Procedure

The test shall be carried out as follows:

- Place the test sample on the cylinder and the funnel on top of the test sample.
- Heat the steel ball to $(900 \pm 20) ^\circ\text{C}$.
- Withdraw the ball from the heat source and drop it as quickly as possible into the funnel.

NOTE If the lens of the test sample is curved, it is mounted curved side facing up on the supporting cylinder.

- Start the timer; record the time required before the ball drops through the protector or that it has resisted the ball for 20 s or more.

7.6.2.4 Test report

For each test sample, report whether the steel ball penetrated it in less than the required minimum time in seconds and if it met the time specified in the applicable product's requirement standard.

8 Marking and packaging

8.1 Principle

This test is intended to demonstrate that the markings on the protector and the information on the packaging are in accordance with the relevant product's requirement standard.

8.2 Procedure

The test shall be carried out as follows:

- Check markings on the components of the test sample, including the lens or filter, and compare with the labels and other information on the packaging.

8.3 Test report

Record whether markings and packaging are in accordance with the product's requirement standard.

9 Information to be supplied by the manufacturer

9.1 Principle

This test is intended to demonstrate that information provided on the packaging and in packaging inserts comply with the requirements of the relevant product's requirement standard.

9.2 Procedure

The test shall be carried out as follows:

- Examine the packaging and packaging inserts provided with the test sample by the manufacturer.

9.3 Test report

Record whether the information to be supplied by the manufacturer is in accordance with the product's requirement standard.