
Personal protective equipment — Test methods for sunglasses and related eyewear

Équipement de protection individuelle — Méthodes d'essai pour lunettes de soleil et articles de lunetterie associés

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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 document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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

This document was prepared by Technical Committee ISO/TC 94 *Personal safety — Personal protective equipment*, Subcommittee SC 6 *Eye and face protection*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 85, *Eye-protective equipment*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 12311:2013), which has been technically revised.

The main changes are as follows:

- with the publication of the four parts of ISO 18526 in 2020, which provides test methods and specifications for head forms for the compliance testing of eye protectors, it was deemed unnecessary to reproduce details of these test methods in ISO 12311. They have therefore been removed. Test methods that have been retained in this document are those developed originally for testing of spectacle frames, that cannot be found in ISO 18526-3. Corresponding Annexes that supplemented the now deleted test methods have also been removed.

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.

Personal protective equipment — Test methods for sunglasses and related eyewear

1 Scope

This document specifies reference's test methods for determining the properties of sunglasses given in ISO 12312 (all parts). It is applicable to all sunglasses and related eyewear.

Other test methods can be used if proven to be equivalent.

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 1042, *Laboratory glassware — One-mark volumetric flasks*

ISO 3696, *Water for analytical laboratory use — Specification and test methods*

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

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

ISO/IEC Guide 98-3, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4007 and ISO 8624 apply.

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

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

4 Prerequisites

The following parameters shall be specified prior to testing [see ISO 12312 (all parts)]:

- the number of test samples;
- test sample preparation;
- any conditioning prior to testing;
- 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 which are not stated as maxima or minima shall be subject to a tolerance of ± 5 %. Unless otherwise specified, the ambient temperature for testing shall be between 16 °C and 32 °C. Where other temperature limits are specified, they shall be subject to an accuracy of ± 2 °C. Relative humidity shall be maintained at (50 ± 20) %.

Unless otherwise specified, the filters shall be tested at the reference points as defined in ISO 4007.

6 Test methods for mechanical properties

6.1 Test method for frame deformation and filter retention

6.1.1 Principle

This procedure tests the ability of the complete sunglass to resist deformation and to retain the filters.

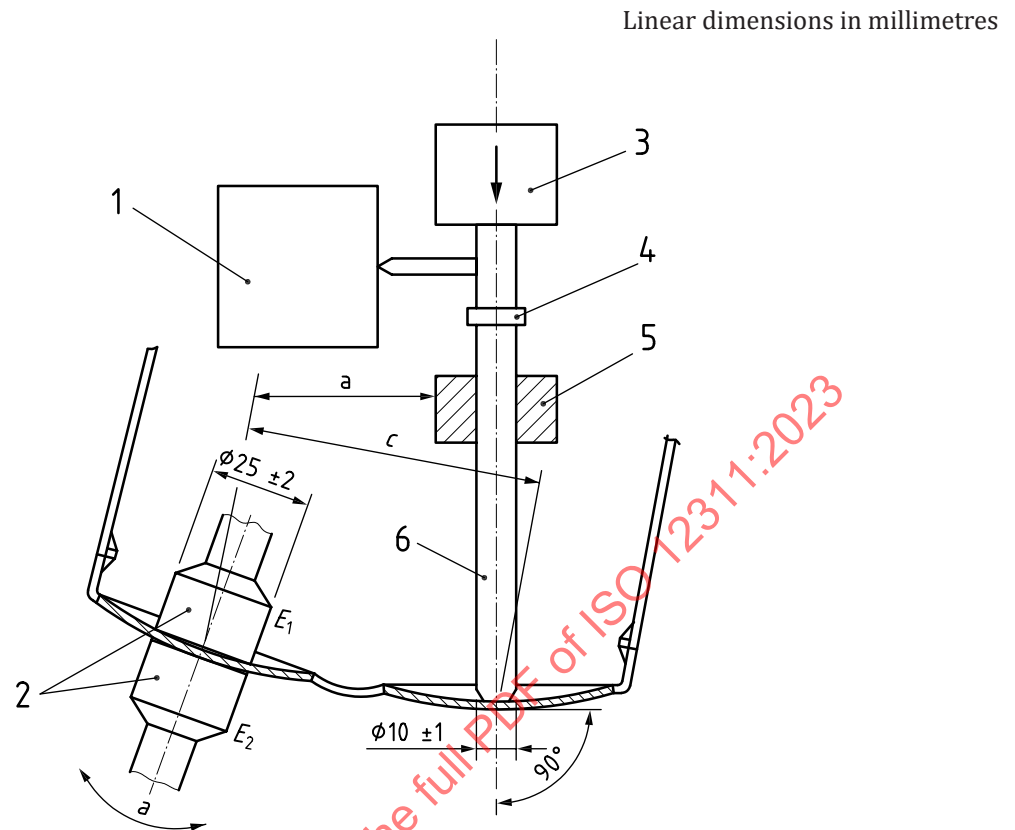
6.1.2 Apparatus

6.1.2.1 Overall scheme, the test apparatus consists of an annular clamp, a downward-operating pressure peg and a measuring device. See [Figure 1](#).

6.1.2.2 Annular clamp, (see [Figure 1](#), key item 2) shall be capable of holding the test sample without twist or slip and have an outside diameter of (25 ± 2) mm, with two contact surfaces, E_1 and E_2 , made of a firm elastic material (e.g. polyamide). The clamping surfaces shall be capable of being separated at least 10 mm on either side of a horizontal line going through the apparatus. To accommodate frames with a significant face form angle, the annular clamp shall also be capable of rotating about a horizontal axis so that the axis of the pressure peg ([6.1.2.3](#)) remains vertical and perpendicular to the plane of the unclamped filter at its boxed centre.

6.1.2.3 Pressure peg, (see [Figure 1](#), key item 6) which operates vertically downwards shall have a diameter of (10 ± 1) mm with a nominally hemispherical contact surface. The pressure peg shall be capable of travelling from at least 10 mm above the horizontal line to not more than 8 mm below. The horizontal distance between the annular clamp and pressure peg is adjustable. The pressure peg slides in a guiding sleeve (See [Figure 1](#), key item 5) that maintains its vertical orientation and lateral position.

6.1.2.4 Measuring device, (see [Figure 1](#), key item 1) to measure the linear displacement of the pressure peg, with an uncertainty no greater than $\pm 0,1$ mm.

**Key**

- 1 measuring device
- 2 annular clamp
- 3 direction and point of application of force (maximum 5 N)
- 4 displacement limiting device (optional)
- 5 guiding sleeve
- 6 pressure peg
- c boxed centre distance (adjustable)
- E_1, E_2 contact surfaces
- a Adjustable.

Figure 1 — Illustration of frame deformation and filter retention test

6.1.3 Procedure

6.1.3.1 Mount the test sample on the device with the sides of the sample extended and with the front of the sample facing downwards. Clamp the sample within 2 mm of the boxed centre of one filter (see [Figure 1](#)).

If the sides are in the way of mounting the frame, e.g. jointless sides, then it is permissible to remove them, but if so, the endurance test ([6.2](#)) shall be performed first. Since the endurance test may be a more severe test of the frame's mechanical strength, the preferred option is to subject the sample to the bridge deformation and filter retention test before the endurance test.

Lower the pressure peg so that it rests on the back surface of the unclamped filter within 2 mm of its boxed centre, ensuring that there is no movement of the filter. Record the reading on the linear measuring device as the starting position.

Move the pressure peg slowly and smoothly downwards, increasing the force until whichever of the following criteria is reached first:

- a) a maximum force of 5 N;
- b) a displacement of the pressure peg from the starting position equal to (10 ± 1) % of the distance between boxed centres, c . An optional displacement limiting ring (see [Figure 1](#), key item 4) can be used to limit the movement of the pressure peg.

6.1.3.2 If the maximum force of 5 N is insufficient to displace the pressure peg over the distance specified in [6.1.3.1 b\)](#), record the displacement and continue the test.

Maintain the force or displacement, whichever was achieved first, for 5 s, then remove the force and lift the pressure peg away from the filter. After a relaxation period of 20 s, slowly and smoothly lower the pressure peg until it just rests on the filter again. Record this as the final position of the pressure peg.

6.1.3.3 Calculate the distance between the starting and final positions of the pressure peg, x , and calculate the percentage deformation using [Formula 1](#).

$$f = \frac{x}{c} \times 100 \quad (1)$$

where

- f is the percentage deformation;
- x is the distance between the starting and final positions of the pressure peg;
- c is the distance between the boxed centres

Check that the sunglass frame shows no fracture.

6.1.3.4 The sunglass frames shall be inspected, without the aid of magnification, by a trained observer. During the examination, expose the test sample to an illuminance of 1 000 lx to 2 000 lx and carry out the inspection against a matt black background. Check that neither filter has been dislodged wholly or partially dislodged from its original location in the groove or mount.

6.1.4 Report

Report whether

- a) the percentage deformation of the sunglass, f , exceeded 2 %,
- b) the maximum load of 5 N achieved the distance specified in [6.1.3.1 b\)](#),
- c) the frame shows any fracture or crack and
- d) either filter has been dislodged wholly or partially from its original location in the groove or mount.

6.1.5 Uncertainty of measurement

An estimate of the uncertainty of measurement associated with this method of test shall be established in accordance with ISO/IEC Guide 98-3. The value of this estimate shall not exceed ± 10 % and shall be applied to the result in accordance with [Annex A](#).

NOTE The use of transfer standards can assist in establishing common uncertainties of measurement between laboratories.

6.2 Test method for increased endurance of sunglasses

6.2.1 Principle

The test aims to simulate the strains on the sunglass frame, particularly the joints, when putting the sunglasses on or taking off. The end of one side is clamped to restrain lateral and prevent rotational movement while the end of the other is rotated through a circle of diameter 60 mm. The bridge is supported, but not clamped, by an artificial nose to restrict movement of the frame.

6.2.2 Apparatus

6.2.2.1 Overall scheme, the test apparatus consists of two clamping devices mounted on universal joints, which are used to move the sides relative to each other, a bridge support and a revolution counter.

The positions of the clamps and bridge support, relative to each other, shall be adjustable by at least 40 mm horizontally and vertically.

The apparatus shall be capable of continuously and smoothly imparting a cyclical motion to one of the universal joints:

- down ($30 \pm 0,5$) mm;
- out ($60 \pm 1,0$) mm;
- up ($30 \pm 0,5$) mm;

at a rate of 40 cycles/min, with the other clamped side remaining fixed, except for the flexure of the universal joint.

For testing in frame development, manufacturers may modify the test equipment so that either the right or the left side is subject to the cyclical motion, the other remaining fixed.

6.2.2.2 Clamping devices, mounted on universal joints, are used to restrain the sides (see [Figures 2](#) and [4](#)). The universal joints shall not restrict the angular movement of the sides. The clamping point, specified as the edge of the clamp nearest the axis of the joint (hinge) or dowel screw axis, shall be (55 ± 1) mm from the centre of the pivot of the universal joint.

6.2.2.3 Bridge support, formed from a horizontal bar of triangular cross-section, enclosing an angle of $30^\circ \pm 2^\circ$ and having a thickness at the top of (12 ± 1) mm with the upper edge approximately radiused (see [Figure 3](#), key item 2).

6.2.2.4 Revolution counter, used to count the number of cycles imparted to one of the spectacle sides.

6.2.3 Procedure

6.2.3.1 Before mounting the test sample on the test apparatus, establish the clamping and measuring points.

Except for curl sides, ensure that the sides are clamped at a distance from the dowel screw centre equivalent to 70 % of the overall side length ± 1 mm. Each measuring point shall be (15 ± 1) mm nearer to the axis of the joint (hinge) or dowel screw axis than the clamping point.

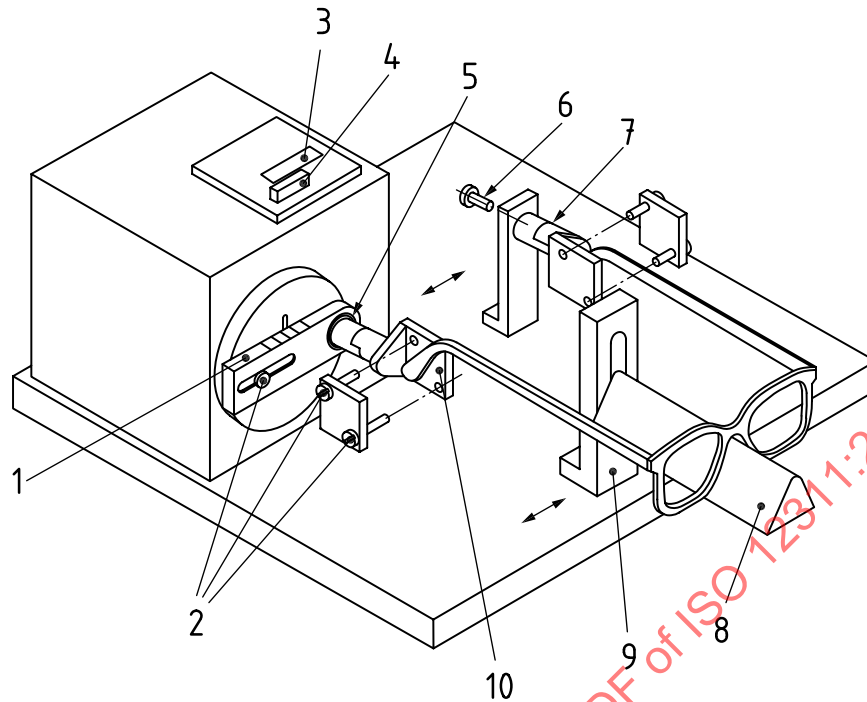
For curl sides, ensure that the clamping points are (3 ± 1) mm nearer to the axis of the joint (hinge) or dowel screw axis than the junction between the curl and the rigid side. Each measuring point shall be (10 ± 1) mm nearer to the axis of the joint (hinge) or dowel screw axis than the clamping point.

For sides without a joint, the reference point for measurement shall be taken as (10 ± 1) mm from the back surface of the lug.

6.2.3.2 Before testing, open the sides of the sunglass frame to the fullest extent, without tension, and measure the distance between the sides at the pre-determined measuring points. Record this distance, d_1 .

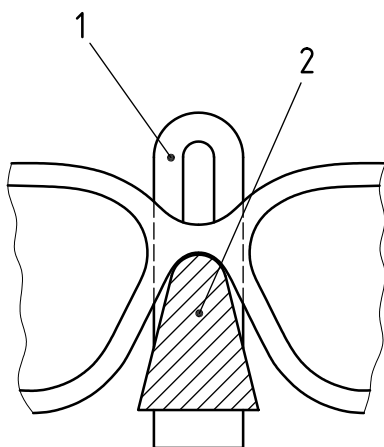
Mount the sunglass frame on the test device, and ensure the following:

- a) that the rotating clamp (see [Figure 4](#), key item 5) is on the same plane as the fixed clamp (see [Figure 4](#), key item 4) and that it is positioned at the nearest point of its rotation towards the fixed clamp;
- b) that the bridge of the sunglass frame is freely supported on the bridge support (see [Figure 4](#), key item 6, see also [Figure 3](#));
- c) that the horizontal relationship between the fixed clamp (see [Figure 4](#), key item 4), the bridge support (see [Figure 4](#), key item 6) and the rotating clamp (see [Figure 4](#), key item 5) are such that the sunglass frame can be mounted with sides fully open, but not under tension, and with the bridge support midway between the clamps;
- d) that the height of the bridge support is adjusted so as to ensure that the sides are in line with the axis of the clamps and parallel to the base of the device;
- e) that the sides are clamped within 1 mm of the calculated clamping point;
- f) that the lockscrew (see [Figure 2](#), key item 6) is loosened to allow the fixed clamp to align with the inward angle of drop of the side, and then re-tightened so that no rotation around the axis of the lockscrew occurs;
- g) that the revolution counter is set to zero.

**Key**

- 1 frame displacement amplitude scale
- 2 finger screws
- 3 counter window
- 4 control switch
- 5 ball bearing
- 6 lock screw
- 7 universal joint
- 8 adjustable sunglass bridge support
- 9 adjustable bracket to match various sunglass frame sizes
- 10 clamping point

Figure 2 — General test arrangement showing clamping device

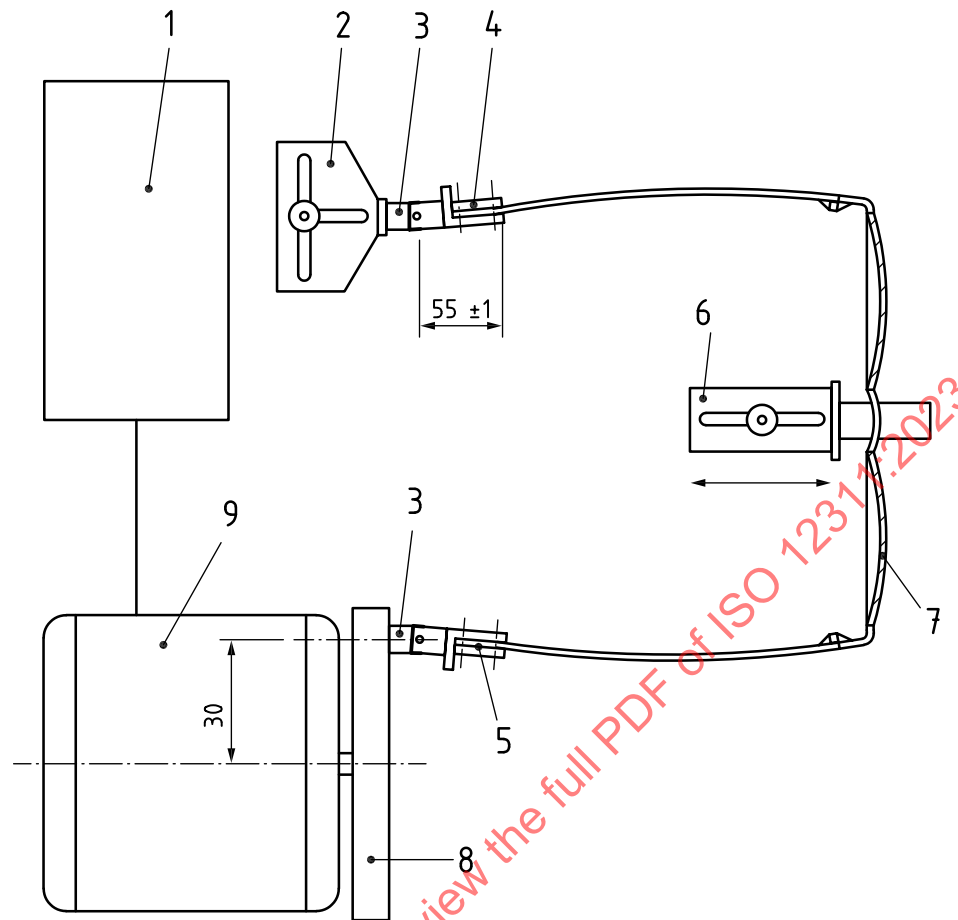


Key

- 1 vertical support with slot to facilitate height adjustment
- 2 horizontal bar, located through a slot in the vertical support

NOTE See the text of [6.2.2.3](#) for dimensions.

Figure 3 — Detail of adjustable bridge support for endurance test rig



Key

- 1 control panel and counter
- 2 side clamp adjustment
- 3 universal joint
- 4 fixed clamp
- 5 rotating clamp
- 6 adjustable sunglass frame bridge support assembly
- 7 test sample
- 8 rotating disc
- 9 geared motor

Figure 4 — Diagram of typical test apparatus

6.2.3.3 With the test sample, complete with its filters, in position, set the apparatus in motion, subjecting the test sample to the cyclical rotating movement described in [6.2.2.2](#) to up to 5 cycles of the rotating movement. If the bridge of the spectacle frame lifts completely off the bridge support, add an elastic retaining band to prevent this but allowing the frame to move almost to the top of the support. Then continue the test to a total of (500^{+1}_0) cycles.

After the (500^{+1}_0) cycles have been completed, stop the motion and remove the test sample from the apparatus. Measure the distance between the sides at the measuring point and record the distance, d_2 , in millimetres. Check that the difference between d_1 and d_2 does not exceed 5 mm.

The sunglass frames shall be inspected, without the aid of magnification, by a trained observer.

During the examination, expose the test sample to an illuminance of 1 000 lx to 2 000 lx and carry out the inspection against a matt black background.

Record any fracture, cracks or change in side movement (see ISO 12312-1).

6.2.4 Report

Report on whether or not the difference between d_1 and d_2 exceeds 5 mm and whether the sunglass frame shows any fracture, cracks or change in side movement.

6.2.5 Uncertainty of measurement

An estimate of the uncertainty of measurement associated with this method of test shall be established, as described in ISO/IEC Guide 98-3. The value of this estimate shall not exceed $\pm 0,5$ mm and shall be applied to the result in accordance with [Annex A](#).

NOTE The use of transfer standards can assist in establishing common uncertainties of measurement between laboratories.

6.3 Test for resistance to perspiration of the sunglass frame

6.3.1 Principle

Complete sunglasses are exposed to an artificial sweat and then inspected for flaws.

6.3.2 Apparatus and reagents

6.3.2.1 Oven, capable of producing the test temperature of (55 ± 5) °C.

6.3.2.2 Container, of glass or inert plastic of minimum dimensions 200 mm across and height of 90 mm, capable of being closed.

6.3.2.3 Volumetric flask, 1 l, gauged to class A of ISO 1042.

6.3.2.4 Water, conforming to Grade 3 of ISO 3696.

6.3.2.5 Artificial sweat solution, comprising:

- a) lactic acid, > 85 % mass fraction purity;
- b) sodium chloride (of recognised pro analysis, p.a., grade or better).

Using suitable containers, weigh $(50 \pm 0,1)$ g of lactic acid [[6.3.2.5 a\)](#)] and $(100 \pm 0,1)$ g of sodium chloride [[6.3.2.5 b\)](#)] and dissolve in 900 ml of water ([6.3.2.4](#)). Using the flask ([6.3.2.3](#)), make up to 1 l with water.

6.3.2.6 Sunglasses frame supports, of glass or inert plastic, fitted in the container so that the sample(s) are held at no less than the specified distance above the artificial sweat solution (see [6.3.2.5](#) and [Figure 5](#)). The supports can be designed to hold several test samples stacked one above another, or side by side, or both, but without contact with each other.

6.3.3 Procedure

6.3.3.1 Cover the base of the container (6.3.2.2) with the artificial sweat solution (6.3.2.5) to a minimum depth of 10 mm so that the lowest part of the (lowest, if stacked) frame shall be not less than 12 mm above the solution.

Place the sunglass, complete with its filters, on the supports (6.3.2.6), with the sides open to the fullest extent (for frames with sprung hinges, opened to the fullest natural extent without activating the spring mechanism), and with the bottom edges of the sides resting on the supports (see Figure 5). Ensure that the sunglass frame does not touch other test samples or the container walls.

Close the container, place it in the oven (6.3.2.1) and maintain at $(55 \pm 5) ^\circ\text{C}$.

6.3.3.2 After $(8,0 \pm 0,5)$ h, remove each test sample and immediately wash with water (6.3.2.4) and then dry without rubbing, using a soft cloth.

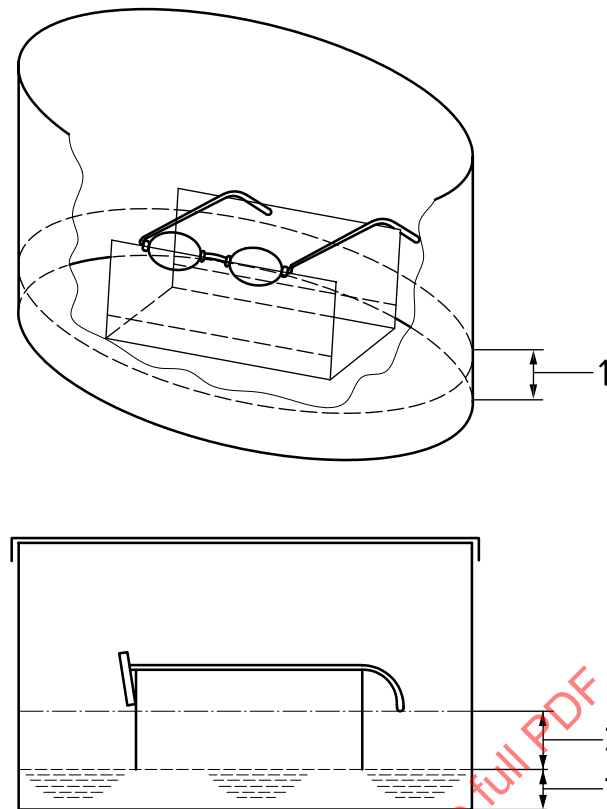
6.3.3.3 Within 30 min, examine each test sample using the inspection conditions described in 6.3.3.6. By comparison with an identical untested sunglass frame, check for and record any spots or change in colour (excluding a loss of gloss to the surface) anywhere on the frame, excluding joints and screws.

6.3.3.4 Replace the test sample(s) on the support(s), close the container and maintain the test temperature of $(55 \pm 5) ^\circ\text{C}$ for a further $(16,0 \pm 0,5)$ h. After completion of this second period, remove, clean and dry the test sample(s) as described in 6.3.3.2.

6.3.3.5 Within 30 min, examine those areas of each test sample that are liable to come into prolonged contact with the skin of the wearer, using the inspection conditions described in 6.3.3.6. By comparison with an identical untested sunglass frame, check for and record any corrosion, surface degradation or separation of any coating layer on the parts liable to come into prolonged contact with the skin during wear, i.e. the insides of the sides, bottom and lower parts of the rim and the inside of the bridge. If the sunglass frame is made from natural materials and the manufacturer recommends a cream or wax for its maintenance, then before testing the sunglass frame(s) shall be prepared with this cream or wax according to the manufacturer's instructions. At the end of the test when the sunglass frame is checked for colour change or surface degradation, if the sunglass frame fails this requirement, use the cream or wax and wait for one day before checking again for colour change or surface degradation. If the frame has recovered its original appearance, the sunglass frame is considered to have passed the test; if the frame remains discoloured, the frame is considered to have failed the test.

6.3.3.6 The sunglass frames shall be inspected without the aid of magnification by a trained observer.

During the examination, expose the test sample and reference specimen to an illuminance of 1 000 lx to 2 000 lx and carry out the inspection against a matte black background.



Key

- 1 artificial sweat
- 2 separation of lowest part of sample from artificial sweat (minimum 12 mm)

Figure 5 — Diagram of typical sunglasses frame support

6.3.4 Report

Report, regarding the sunglass frame only:

- any spots or change in colour (excluding a loss of gloss to the surface) anywhere on the frame, excluding joints and screws, after 8 h,
- any corrosion, surface degradation (e.g. roughness, orange peel appearance) or separation of any coating layer on the parts liable to come into prolonged contact with the skin during wear, i.e. the insides of the sides, bottom and lower parts of the rim and the inside of the bridge, after 24 h,

by comparison with an untested sunglass.