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Optics and optical instruments — Optical coatings —

Part 4: Specific test methods (standards.iteh.ai)

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ISO 9211-4:1996
*Optique et instruments d'optique — Traitements optiques —
Partie 4: Méthodes d'essai spécifiques*



Reference number
ISO 9211-4:1996(E)

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 9211-4 was prepared by Technical Committee ISO/TC 172, *Optics and optical instruments*, Subcommittee SC 3, *Optical materials and components*.

ISO 9211 consists of the following parts, under the general title *Optics and optical instruments — Optical coatings*:

- Part 1: *Definitions*
- Part 2: *Optical properties*
- Part 3: *Environmental durability*
- Part 4: *Specific test methods*

Annex A forms an integral part of this part of ISO 9211. Annex B is for information only.

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Optics and optical instruments — Optical coatings —

Part 4: Specific test methods

1 Scope

ISO 9211 describes surface treatments of components and substrates excluding ophthalmic optics (spectacles) by the application of optical coatings and gives a standard form for their specification. It defines the general characteristics and the test and measurement methods whenever necessary, but is not intended to define the process method.

This part of ISO 9211 describes specific test procedures for coating environmental durability tests that are identified in ISO 9211-3 but not described in other normative references.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 9211. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 9211 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 48:1994, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)*.

ISO 9022-1:1994, *Optics and optical instruments — Environmental test methods — Part 1: Definitions, extent of testing*.

ISO 10110-7:1996, *Optics and optical instruments — Preparation of drawings for optical elements and systems — Part 7: Surface imperfection tolerances*.

3 Test conditioning

Before and after subjecting a coated specimen (component or witness sample) to any inspection or test, the specimen shall be thoroughly cleaned as required to remove dirt, finger marks, smears, etc.

4 Abrasion resistance tests

The purpose of these tests is to evaluate to what extent the optical and mechanical properties of optical coatings on components and substrates are affected when subjected to specific abrading conditions at ambient atmospheric conditions in accordance with ISO 9022-1.

4.1 Test conditions

4.1.1 General

Abrasion tests shall be conducted using a coating abrasion tester capable of meeting the requirements of this clause and in particular 4.1.2, 4.1.3 and 4.2. The length of stroke of the tester shall be approximately 20 mm when the dimensions of the specimen permit. A stroke is defined as one pass in one direction on the surface being tested. The tester shall be operated in a cycling mode. A cycle is defined as one stroke in one direction, followed by a return stroke in the opposite direction. The head of the tester shall be approximately normal to the surface under test during the rubbing operation. The specimen shall be firmly held so that it does not slide during the test.

4.1.2 Moderate abrasion test

The rubbing head of the abrasion tester shall be covered with a pad of clean, dry, laundered cotton

cheesecloth approximately 5 mm thick by 10 mm wide. The cheesecloth shall be unbleached, the warp shall have 41 to 47 yarns per 25 mm, and the filling shall have 33 to 39 yarns per 25 mm. The total number of yarns in a 25 mm by 25 mm square shall be 76 to 84.

4.1.3 Severe abrasion test

The rubbing head of the abrasion tester shall be affixed with a standard eraser, conforming to annex A. The eraser shall be inserted into the holder so that the exposed length does not exceed 3 mm.

It is permissible to clean the eraser with a clean towel, but solvents should not be used. Also, the eraser may be conditioned by rubbing it across a clean glass surface to wear some of the rubber away if embedded foreign material is suspected.

4.2 Conditioning (Conditioning method 01: Abrasion)

The degrees of severity for conditioning method 01 are given in table 1.

Table 1 — Degrees of severity for conditioning method 01: Abrasion

Degree of severity	01	02	03	04
Abrader	Cheese-cloth	Cheese-cloth	Eraser	Eraser
Number of strokes	50	100	20	40
Force	5 N ± 1 N	5 N ± 1 N	10 N ± 1 N	10 N ± 1 N

4.3 Recovery

Subsequent to the rubbing operation the specimen shall be cleaned as described in clause 3.

4.4 Evaluation

The film on the specimen shall be visually examined in reflected and/or transmitted light, with the unaided eye, for evidence of physical damage to the coating. The examination shall be performed using the method specified in annex B, or in accordance with ISO 10110-7, or shall be agreed upon between the

supplier and the user. The method used shall be stated. The coating shall not show any evidence of damage, such as abrasion or coating removal. If slight sleeking or scratching is visible and the cheesecloth or eraser and/or coating is suspected of having foreign material embedded in it, retest another area of the surface using a fresh cheesecloth pad or eraser.

5 Adhesion tests

The purpose of these tests is to evaluate to what extent the mechanical properties of optical coatings on components and substrates are affected when subjected to specific tensile or shear stress conditions at ambient atmospheric conditions in accordance with ISO 9022-1.

5.1 Test conditions

The pressure-sensitive adhesive tape used for this test shall be clear in colour with an adhesive strength of at least 9,8 N per 25 mm width. It shall be 12 mm to 13 mm wide. It shall show no evidence of deterioration and shall be capable of being unwound from the roll at a normal rate of speed without showing evidence of adhesive offsetting, adhesive splitting, or stringing out of adhesive, nor breakage or splitting of the tape backing. The tape shall be free of bare spots or foreign particles or any defect that may affect serviceability or appearance.

5.2 Conditioning (Conditioning method 02: Adhesion)

The degrees of severity for conditioning method 02 are given in table 2.

5.2.1 Apply approximately 25 mm of tape to the coated surface when the dimensions of the specimen permit, with sufficient tape remaining to securely grasp with a thumb and finger.

5.2.2 Press the tape firmly onto the coated surface. Rub the non-adhesive surface of the tape with a finger to assure firm contact with the specimen and to work out any air bubbles that may be present.

5.2.3 Do not apply the tape within 2 mm of any rim of the specimen unless otherwise required in the relevant specification. (See 6.3 of ISO 9211-1:1994 for "rim" definition.)

5.2.4 Hold the specimen firmly in one hand, with one end of the tape that is past the area to be tested in the other hand.

5.2.5 Remove the tape at an angle normal to the coated surface at one of the rates indicated in table 2.

Table 2 — Degrees of severity for conditioning method 02: Adhesion

Degree of severity	01	02	03
Rate of tape removal	Slow (≈ 2 s to 3 s per 25 mm)	Quick (≈ 1 s per 25 mm)	Snap (≪ 1 s per 25 mm)
NOTE — The “snap” rate of removal refers to a snapping action of the wrist and fingers.			

5.3 Recovery

Do not clean the specimen prior to evaluation.

5.4 Evaluation

The film on the specimen shall be visually examined in reflected and/or transmitted light, with the unaided eye, for evidence of coating removal. The examination shall be performed using the method specified in annex B, or in accordance with ISO 10110-7, or shall be agreed upon between the supplier and the user. The method used shall be stated. The coating shall not show any evidence of coating removal.

Unless otherwise required in the relevant specification, visual discolourations of the coating such as stains, smears, streaks, or cloudiness shall be acceptable if the specimen conforms to the optical and other environmental durability requirements of the relevant specification.

6 Solubility tests

The purpose of these tests is to evaluate to what extent the optical and mechanical performance characteristics of optical coatings on components and substrates are affected after immersion in distilled or deionized water or a salt water solution.

6.1 Test conditions

6.1.1 The test container shall be glass or ceramic, with a volume adequate to completely submerge the test part(s).

6.1.2 The specimen(s) shall be held in the test container with a specimen holder made of non-reactive material, such as polytetrafluoroethylene (PTFE) or acetal polymer.

6.1.3 The water used for tests shall be distilled or deionized; its resistivity shall be greater than or equal to 0,2 MΩ·cm, at a temperature of 23 °C ± 2 °C.

6.1.4 The pH of the water or salt solution shall be between 6,5 and 7,2, measured at a temperature of 23 °C ± 2 °C. Only diluted chemically pure hydrochloric acid or chemically pure sodium hydroxide solution shall be used to adjust the pH. The pH shall be measured either electrometrically by means of a glass electrode, or colourmetrically using bromothymol blue as an indicator.

6.1.5 The salt water solution shall be prepared by dissolving sodium chloride in water at room temperature to obtain a concentration of 45 g/l. The sodium chloride shall not contain more than 1 % total impurities.

6.2 Conditioning (Conditioning method 03: Solubility)

The degrees of severity for conditioning method 03 are given in table 3.

Table 3 — Degrees of severity for conditioning method 03: Solubility

Degree of severity	01	02	03
Exposure time	6 h	24 h	24 h
Solution	Distilled or deionized water	Distilled or deionized water	Salt water

6.3 Recovery

After immersion, specimens subjected to the water solubility test shall be dried with a soft clean cloth. Specimens subjected to the salt solution shall be gently washed in distilled or deionized water not warmer than 38 °C to remove salt deposits. Specimens then shall be dried with a soft clean cloth or with filtered dry nitrogen gas.

6.4 Evaluation

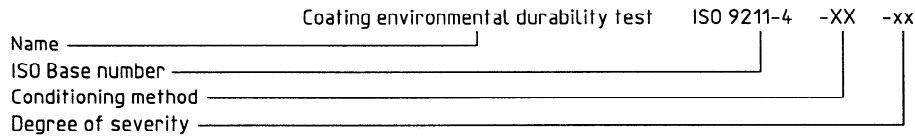
The film on the specimen shall be visually examined in reflected and/or transmitted light, with the unaided

eye, for evidence of flaking, peeling, cracking, or blistering. The examination shall be performed using the method specified in annex B, or in accordance with ISO 10110-7, or shall be agreed upon between the supplier and the user. The method used shall be stated. The coating shall not show any evidence of physical deterioration.

Unless otherwise required in the relevant specification, visual discolourations of the coating such as stains, smears, streaks, or cloudiness shall be acceptable if the specimen conforms to the optical and other environmental durability requirements of the relevant specification.

7 Environmental test code

Code for coating environmental durability tests shall be formed as follows:



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Annex A (normative)

Eraser (rubber-pumice) for testing optical coatings

This annex defines the requirements for the eraser used to test the abrasion resistance of optical coatings.

A.1 Material

The eraser¹⁾ shall be a uniform mixture of rubber and abrasive, formed by an extrusion process. It shall be composed of not less than 15 % by weight of pumice. All abrasive shall be fine ground, such that 100 % will pass through a sieve with opening 45 μm . The formulation shall not contain any ingredient that might leave a residue on the surface under test that would lubricate subsequent strokes during the test procedure.

A.2 Hardness

The finished eraser shall have an international rubber hardness degree (IRHD) in accordance with ISO 48 of 75 ± 5 on both ends.

A.3 Accelerated aging

The eraser shall show a hardness change of not more than 10 points after being placed in an air oven for seven days at a temperature of $70 \text{ }^\circ\text{C} \pm 2 \text{ }^\circ\text{C}$.

A.4 Shape and size

The diameter of the eraser shall be from 6,5 mm to 7 mm. It shall be of sufficient length to be held securely in the abrasion tester with not more than 3 mm exposed.

A.5 Workmanship

The eraser shall be free from any excessive holes, cracks, splits, or foreign particles which might adversely affect its use.

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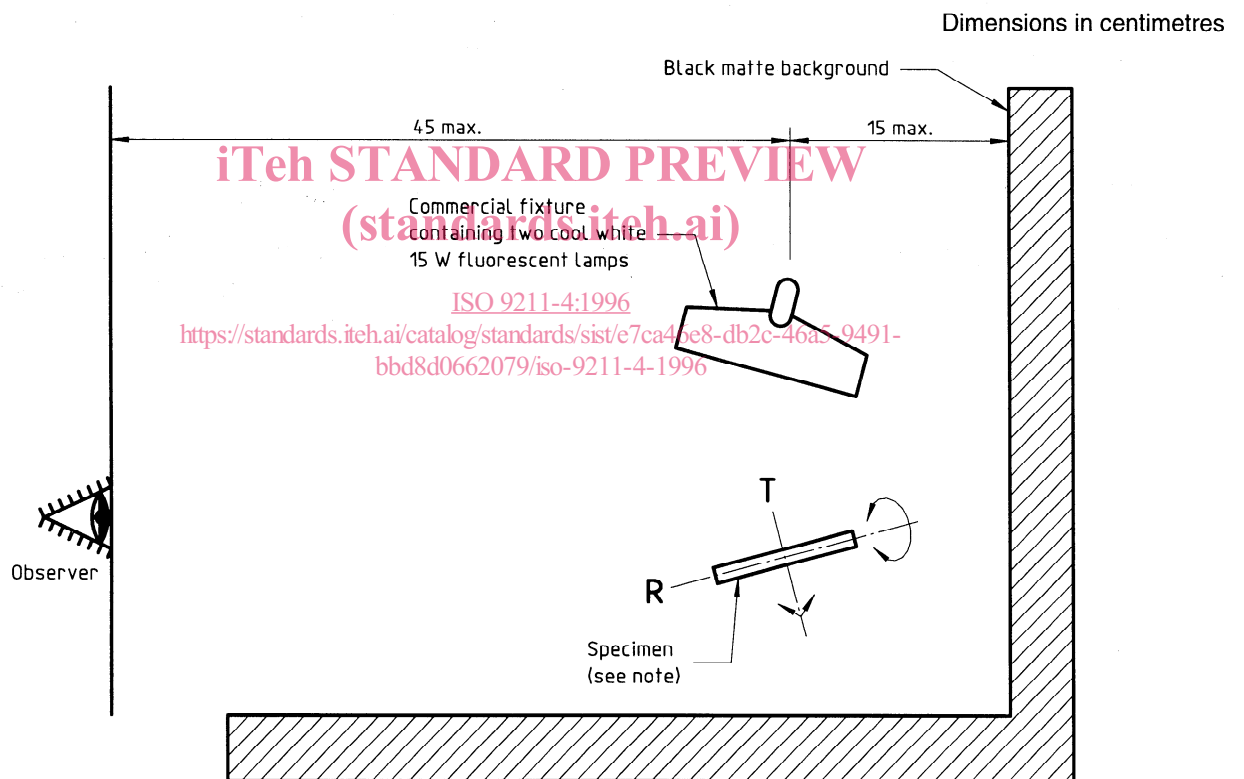
1) Erasers manufactured to these requirements are available from Summers Laboratories, P.O. Box 162, Fort Washington, PA 19034, USA. This information is given for the convenience of users of this part of ISO 9211 and does not constitute an endorsement by ISO of this source of supply. Equivalent erasers may be available from other sources, and may be used subject to agreement between supplier and user.

Annex B (informative)

Visual examination of optical coatings

Visual examination of optical coatings by this method shall be performed using two cool white 15 W fluorescent light bulbs as the light source. The viewing distance from the coated surface to the eye shall not exceed 45 cm. The coated surface shall be viewed

against a black matte background. The only illumination in the inspection area shall be from the light source used for examination. This method of examination is depicted in figure B.1.



NOTE — Tilt the specimen at an appropriate angle to see the coated surface (R = reflective viewing, T = transmissive viewing).

Figure B.1 — Method of examination

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