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Road vehicles — Safety glazing materials — Test methods for resistance to radiation, high temperature, humidity, fire and simulated weathering

Véhicules routiers — Vitrage de sécurité — Méthodes d'essai de résistance au rayonnement, aux températures élevées, à l'humidité, au feu et aux intempéries simulées

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Foreword

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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 3917 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Sub-Committee SC 11, *Safety glazing materials*.

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Road vehicles — Safety glazing materials — Test methods for resistance to radiation, high temperature, humidity, fire and simulated weathering

1 Scope

This International Standard specifies test methods for resistance to radiation, high temperature, humidity, fire and simulated weathering, relating to the safety requirements for all safety glazing materials in a road vehicle, whatever the type of glass or the material of which they are composed. Terms used are in conformity to ISO 3536.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard 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 3536:1992, *Road vehicles — Safety glazing materials — Vocabulary.*

ISO 3537:—[1], *Road vehicles — Safety glazing materials — Mechanical tests.*

ISO 3538:1978, *Road vehicles — Safety glasses — Test methods for optical properties.*

ISO 3795:1989, *Road vehicles, and tractors and machinery for agriculture and forestry — Determination of burning behaviour of interior materials.*

ISO 4892:1981, *Plastics — Methods of exposure to laboratory light sources.*

ISO 4892-2:—[2], *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon arc sources.*

ISO 4892-4:—[2], *Plastics — Methods of exposure to laboratory light sources — Part 4: Open-flame carbon arc lamp.*

3 Test conditions

Unless otherwise specified, the tests shall be carried out under the following conditions:

Ambient temperature: 20 °C ± 5 °C

Atmospheric pressure: 86 kPa to 106 kPa (or 860 mbar to 1 060 mbar)

Relative humidity: (60 ± 20) %

4 Application of tests

For certain types of safety glazing material, it is not necessary to carry out all the tests specified in this International Standard when the results, according to the purpose of testing, can be predicted with certainty from knowledge of the properties of the safety material concerned.

5 Radiation test

5.1 Principle

Determination of whether exposure to radiation over an extended period of time produces any appreciable decrease in regular luminous transmittance or any pronounced discoloration of the safety glazing material.

1) To be published. (Revision of ISO 3537:1975)

2) To be published.

5.2 Apparatus

5.2.1 Radiation source consisting of a medium-pressure mercury arc lamp with a tubular quartz bulb of ozone-free type; the bulb axis shall be vertical. The nominal dimensions of the lamp shall be 360 mm in length by 9,5 mm in diameter. The arc length shall be 300 mm ± 14 mm. The lamp shall be operated at 750 W ± 50 W.

Any other source of radiation which produces the same effect as the lamp specified above may be used. To check that the effects of another source are the same, a comparison shall be made by measuring the amount of energy emitted within a wavelength range of 300 nm to 450 nm, all other wavelengths being removed by the use of suitable filters. The alternative source shall then be used with these filters.

In the case of safety glazing material for which there is no satisfactory correlation between this test and the conditions of use, it will be necessary to review the test conditions.

5.2.2 Power supply transformer and **capacitor** which shall be capable of supplying to the lamp (5.2.1) a starting peak voltage of 1 100 V minimum and an operating voltage of 500 V ± 50 V.

5.2.3 Device for mounting and rotating the test specimens at 1 r/min to 5 r/min about the centrally located radiation source in order to ensure even exposure.

5.3 Test specimen

The size of the test specimens shall be 76 mm × 300 mm.

5.4 Procedure

Measure the regular luminous transmittance, determined according to ISO 3538, of three test specimens before exposure. Protect a portion of each test specimen from the radiation, and then position the test specimen in the test apparatus 230 mm from, and with its 300 mm dimension parallel to, the lamp axis. Maintain the temperature of the test specimens at 45 °C ± 5 °C throughout the test.

The surface of each test specimen which would represent the outside face of the safety glazing material when mounted on the vehicle shall face the lamp. For the type of lamp specified in 5.2.1, the exposure time shall be 100 h.

After exposure, measure the luminous transmittance again on each test specimen in the exposed area.

5.5 Expression of results

The results of the luminous transmission measurement of the exposed test specimen shall be compared with the values obtained for unexposed test specimens of the same material. The deviation shall be expressed as a percentage.

Changes in colour shall be evaluated:

— either by examining the test specimens placed upon a white background and comparing the exposed area with the area which was protected from the radiation;

— or by measuring the trichromatic co-ordinates of the test specimen before and after ageing and by calculating the difference between two colours according to the CIE[3] prescriptions.

6 High temperature test

6.1 Principle

Determination of whether the safety glazing material will withstand exposure to high temperatures over an extended period of time without its appearance becoming substantially altered.

6.2 Procedure

Heat one or more test specimens of at least 300 mm × 300 mm to 100 °C $^{0}_{-2}$ °C. Maintain this temperature for a period of 2 h, then allow the test specimen(s) to cool to room temperature.

If the safety glazing material has both external surfaces of inorganic material, the test may be carried out by immersing the test specimen vertically in water boiling at 100 °C $^{0}_{-2}$ °C for the specified period of time, care being taken to avoid undue thermal shock.

If specimens are cut from windscreens, one edge of the test specimen shall be part of an edge of the windscreen.

6.3 Expression of results

The resistance of the safety glazing material to high temperatures shall be evaluated with reference to bubbles or other defects produced in the test specimen by the above test.

Any defects within 15 mm of an uncut edge, 25 mm from a cut edge or within 10 mm of any cracks which may develop shall be disregarded.

Any test specimen in which cracks develop to an extent which might confuse the results shall be dis-

3) International Commission on Illumination.

carded and another test specimen shall be tested in its place.

7 Humidity test

7.1 Principle

Determination of whether the safety glazing material will successfully withstand the effects of humidity in the atmosphere over an extended period of time.

7.2 Procedure

Keep one or more test specimens of at least 300 mm × 300 mm vertically for 2 weeks in a closed container in which the temperature is maintained at 50 °C ± 2 °C and the relative humidity at (95 ± 4) %.

These test conditions should exclude any condensation on test specimens.

In the event that several test specimens are tested at the same time, adequate spacing shall be provided between the test specimens.

Precautions shall be taken to prevent condensate from the walls and ceiling of the test chamber from falling on the test specimens.

If the test specimens are cut from windscreens, one edge of the test specimen shall be part of an edge of the windscreen.

7.3 Expression of results

The resistance to humidity shall be evaluated visually by reference to change in the appearance of the safety glazing material after testing. i.e.:

— separation of materials;

— loss of transparency according to ISO 3538.

A waiting period of 48 h after exposure prior to evaluation is permitted, if necessary.

The changes shall be assessed over the whole test specimen, except within 10 mm of the uncut edges or within 15 mm of the cut edges.

8 Burning behaviour test

8.1 Principle

Determination of the behaviour of the safety glazing material under the action of a small flame.

The method used shall be that specified in ISO 3795.

8.2 Expression of results

The burning behaviour of the safety glazing material shall be evaluated by reference to the burning rate.

9 Resistance to simulated weathering

9.1 Principle

Determination of whether safety glazing materials, of which at least one surface is plastics, will successfully withstand exposure to simulated weathering conditions.

9.2 Exposure apparatus

Two types of light sources are included in this standard, the long arc xenon and open flame carbon arc lamps. Either light source may be used for this test. Because of spectral differences between the xenon arc and open flame carbon arc, however, test results from the two light sources may or may not correlate, depending on the materials under test.

9.2.1 Long arc xenon lamp

The exposure apparatus[4] shall use a long arc xenon lamp as the source of irradiation, which shall comply with ISO 4892-2:—, subclause 4.1.2.[5] méthod A (artificial weathering).

The long arc xenon lamp is advantageous in that it can, when correctly filtered and maintained, yield a spectrum most closely approximating that of natural sunlight. To this end, the quartz xenon burner tube shall be fitted with suitable borosilicate glass optical filter(s)[6] Suprax. [See employed shall be operated, from a suitable 50 Hz or 60 Hz power supply, through suitable reactance transformers and electrical equipment.

The exposure apparatus shall include equipment necessary for measuring and/or controlling the following:

4) Such as Atlas Ci Series, Heraeus Xenotest Series, or Suga WEL-X Series. These are trade-names. This information is given for the convenience of users of this International Standard 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.

5) The user's attention is drawn to the fact that this reference is to a document which has not yet been published (revision, in the form of parts, of ISO 4892:1981) and the subclause numbering may therefore change.

6) Such as Corning 7746 Pyrex or Heraeus Suprax. [See footnote 4) on trade-names.]

a) irradiance;

b) black panel temperature;

c) water spray;

d) operating schedule or cycle.

The exposure apparatus shall be made from inert materials which do not contaminate the water employed in the test.

Irradiance shall be measured at the test specimen surface and shall be controlled according to the recommendations of the exposure apparatus manufacturer.

Total ultraviolet[7] radiant exposure, in joules per square metre, shall be measured or computed and shall be considered the primary measure of test specimen exposure.

9.2.2 Open flame carbon arc lamp

The exposure apparatus[8] shall use an open flame carbon arc lamp as the source of irradiation which shall comply with ISO 4892-4:—, subclause 4.1[5], type 1 filter.

The open flame carbon arc yields a spectrum which is substantially different from natural sunlight. In that portion of the ultraviolet and visible spectrum, between 350 nm and 450 nm, concentration of energy in the cyanogen bands causes the open flame carbon arc to exceed greatly the spectral irradiance of natural sunlight. Except for this region, the open flame carbon arc has a spectral power distribution approximating natural sunlight.

The open flame carbon arc lamps employed shall be operated at 50 V ± 2 V of discharge voltage and 60 A ± 2 A of discharge current. They shall consist of carbon electrodes, of 22 h or 60 h in continuous illumination life, over which glass filters are mounted with spectral transmittances as follows:

255 nm	1 % or less
302 nm	68 % or more
375 nm to 700 nm	90 % or more

Total exposure time shall be the primary measure of test specimen exposure. Measurement or computation of total ultraviolet radiant exposure is optional.

9.3 Test specimens

The dimensions of the test specimen shall normally be those specified in the appropriate test method for the property or properties to be measured after exposure.

The number of test specimens for each test condition or exposure stage shall be determined, in addition to those required for visual evaluations as specified in 9.5, by the number required by the test methods.

It is recommended that visual evaluations be conducted on the largest test specimens tested.

9.4 Procedure

Measure, in accordance with ISO 3538, the luminous transmission of the test specimen(s) to be exposed. Measure, in accordance with ISO 3537, the resistance to abrasion of the plastics surface(s) of the control specimen(s). That face of each test specimen which would represent the surface glazed to the exterior of the road vehicle shall face the lamp.

Other exposure conditions shall be as given in 9.4.1 to 9.4.10.

9.4.1 In accordance with ISO 4892, the irradiance shall not vary more than ± 10 % over the whole test specimen area.

9.4.2 At appropriate intervals, clean lamp filters by washing with detergent and water. Xenon arc filters shall be replaced according to the recommendations of the equipment manufacturer. Open flame carbon arc filters should be replaced after 2 000 h of use, or when pronounced discoloration or milkiness develops, whichever occurs first. It is recommended that two of the filters be replaced at each 500 h interval.

9.4.3 The temperature within the exposure apparatus during the dry portion of the cycle shall be controlled by circulation of sufficient air to maintain a constant black panel temperature.

In the xenon arc exposure apparatus, this temperature shall be 70 °C ± 3 °C as indicated by a black panel thermometer[9] or equivalent. In the open flame carbon arc exposure apparatus, this temperature shall be 63 °C ± 3 °C as indicated by a black panel thermometer or equivalent. The black panel thermometer shall be mounted in the test specimen rack and readings shall be taken at the point where maximum heat is developed due to light exposure.

7) Total ultraviolet is considered to be all radiation of wavelength less than 400 nm.

8) Such as Suga WEL-SUN-Series or Atlas XW Series. [See footnote 4) on trade-names.]

9) The black panel thermometer is described in subclause 5.3 of ISO 4892:1981.

9.4.4 The relative humidity within the exposure apparatus shall be controlled at (50 ± 5) % during the dry portions of the cycle.

9.4.5 The deionized water used in the spray cycle shall contain less than 1 ppm silicon dioxide solids and shall leave no permanent deposit or residue on the test specimens which would interfere with subsequent measurements.

9.4.6 The alkalinity (pH) of the water shall be between 6,0 et 8,0 and the conductivity shall be less than 5 µS.

9.4.7 The temperature of the water in the line where it enters the exposure apparatus shall be the ambient water temperature.

9.4.8 The water shall strike the test specimens in the form of a fine spray in sufficient volume to wet the test specimens uniformly, immediately upon impact.

Water spray shall be directed only against the test specimen surface facing the light source. No recirculation of the spray water or immersion of the test specimens in the water is permitted.

9.4.9 The test specimens shall be rotated about the arc in order to provide uniform distribution of the light. All positions in the exposure apparatus shall be filled with test specimens or surrogates to ensure that a uniform temperature distribution is maintained. Test specimens shall be held in frames with backs exposed to the cabinet environment. However, reflections from cabinet walls shall not be permitted to strike the back surface of specimens. If necessary, samples may be backed to block such reflections so long as free circulation of air at the specimen surface is not impeded.

9.4.10 The exposure apparatus shall be operated to provide continuous light and intermittent water spray in 2 h cycles. Each 2 h cycle, in accordance with ISO 4892, shall be divided into periods during which the test specimens are exposed to light without water spray for 102 min and to light with water spray for 18 min.

9.5 Evaluation

After exposure, the test specimens may be cleaned, if necessary, by a practice recommended by their manufacturer to remove any residues present.

Evaluate the exposed test specimens visually with respect to the following properties:

a) bubbles;

b) colour[10];

c) haze;

d) noticeable decomposition.

Measure, in accordance with ISO 3537 and ISO 3538 respectively, the resistance to abrasion and luminous transmission of the exposed specimens.

9.6 Expression of results

Report visual evaluations of exposed test specimens, comparing the appearance of each with that of the unexposed control specimens. If colour is measured instrumentally, compute and report the colour change.

Report the change in luminous transmission and the change in resistance to abrasion, comparing results of tests on exposed test specimens with results of tests on unexposed control specimens.

9.7 Report of test parameters

Report the following:

a) light source (xenon or open flame carbon arc);

b) apparatus manufacturer and model number;

c) exposure time, in hours;

d) total ultraviolet radiant exposure (optional for open flame carbon arc), in joules per square metre.

10) Colour change may be evaluated optionally by a method given in CIE 15.2:1986, *Colorimetry*.

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