INTERNATIONAL STANDARD

ISO 4892-4

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Plastics — Methods of exposure to laboratory light sources —

Part 4:
Open-flame carbon-arc lamps

Plastiques — Méthodes d'exposition à des sources lumineuses de laboratoire —

Partie 4: Lampes à arc au carbone

Reference number
ISO 4892-4:1994(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 4892-4 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 6, *Ageing, chemical and environmental resistance*.

Together with the other parts of ISO 4892, it cancels and replaces ISO 4892:1981, of which it constitutes a technical revision.

ISO 4892 consists of the following parts, under the general title *Plastics — Methods of exposure to laboratory light sources*:

— *Part 1: General guidance*

— *Part 2: Xenon-arc sources*

— *Part 3: Fluorescent UV lamps*

— *Part 4: Open-flame carbon-arc lamps*

Annex A forms an integral part of this part of ISO 4892. Annexes B and C are for information only.

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Plastics — Methods of exposure to laboratory light sources —

Part 4:
Open-flame carbon-arc lamps

1 Scope

This part of ISO 4892 specifies methods for exposing specimens to open-flame carbon-arc lamps. General guidance is given in ISO 4892-1.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 4892. 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 4892 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 4582:1980, *Plastics — Determination of changes in colour and variations in properties after exposure to daylight under glass, natural weathering or artificial light.*

ISO 4892-1:1994, *Plastics — Methods of exposure to laboratory light sources — Part 1: General guidance.*

3 Principle

3.1 Specimens of the samples to be tested are exposed to a carbon-arc light source under controlled environmental conditions.

3.2 The procedure may include measurements of the irradiance and radiant exposure at the surface of the specimen.

3.3 It is recommended that a similar material of known behaviour be exposed simultaneously with the experimental material as a reference.

3.4 Intercomparison of results obtained from specimens exposed in different apparatus should not be made unless reproducibility has been established among devices for the material to be tested.

4 Apparatus

4.1 Laboratory light source

4.1.1 The lamp comprises an arc formed in free air between carbon rod electrodes. The specifications for the light source are given in annex A.

4.1.2 The radiation reaching the specimens passes through filter elements. The different types of filter element used in practice shall have spectral-transmittance values as specified in table 1 at the wavelengths given in the table.

Table 1 — Spectral transmittance of glass filters at specific wavelengths prior to use

Type 1		Type 2		Type 3	
Wavelength nm	Transmittance %	Wavelength nm	Transmittance %	Wavelength nm	Transmittance %
255	⩽ 1	275	⩽ 2	295	⩽ 1
302	71 to 86	320	65 to 80	320	⩾ 40
⩾ 360	> 91	400 to 700	⩾ 90	400 to 700	⩾ 90

Information on different types of glass filter is given in annex B.

The carbon rods shall be changed in accordance with the manufacturer's instructions.

The characteristics of filters are subject to change during use due to ageing and the formation of deposits, and filters shall therefore be replaced at suitable intervals (see 7.2.2).

4.2 Test chamber (see also annex B)

The test chamber contains a specimen frame, with provision for passing air over the specimens for temperature control.

The frame rotates about the central axis of the carbon-arc holder. A typical frame diameter is 96 cm. Other frame diameters may be used if mutually agreed upon by all interested parties.

The frame shall carry specimens directly as panels and/or in holders attached to the frame. The frame may be vertical or inclined.

The upper and lower electrodes, as well as the filter(s), shall be installed in accordance with the instructions of the manufacturer of the apparatus.

The apparatus shall be fitted with equipment for programming exposure cycles within the operational limits of the apparatus.

4.3 Radiometer

When a radiometer is used, it shall comply with the requirements outlined in ISO 4892-1:1994, subclause 5.2.

4.4 Black-standard/black-panel thermometer

The black-standard or black-panel thermometer used shall comply with the requirements outlined in ISO 4892-1:1994, subclause 5.1.5.

4.5 Relative-humidity control equipment

The relative humidity of the air passing over the test specimens shall be controlled at an agreed value if required and measured by suitable instruments inserted into the test chamber and shielded from the lamp radiation.

4.6 Spray system

4.6.1 The test chamber shall contain a water-spray system equipped with nozzles to produce a uniformly distributed spray on demand. The system shall be constructed of stainless steel, plastic or another material that does not react with or contaminate the water passing through it.

NOTE 1 Suitable filters and demineralizers may be required for use in conjunction with the spray system in order to meet the requirements for water purity.

4.6.2 The spray system shall provide uniform wetting and rapid cooling. Spray water shall drain freely from the wetted surfaces.

4.6.3 Specimens may be sprayed with distilled or demineralized water (having a conductivity below 5 µS/cm) intermittently under specified conditions. The water shall leave no observable stains or deposits and should therefore preferably contain less than 1 ppm of solids. In addition to distillation, a combination of deionization and reverse-osmosis can be used to produce water of the required quality. The pH of the water used shall be reported.

4.6.4 A spray system designed to cool the specimen by spraying the back surface of the specimen or specimen backing may be required when the exposure programme specifies periods of condensation.

4.7 Specimen holders

Specimen holders may be in the form of an open frame, leaving the back of the specimen exposed, or they may provide the specimen with a solid backing. They shall be made from inert materials that will not affect the test results, for example non-oxidizing alloys of aluminium or stainless steel. Brass, steel or copper shall not be used in the vicinity of the test specimens. The backing used may affect the test results particularly with transparent specimens, and therefore shall be agreed on between the interested parties.

4.8 Apparatus to assess changes in properties

The apparatus required by the International Standards relating to the determination of the properties chosen for monitoring (see also ISO 4582) shall be used.

5 Test specimens

Refer to ISO 4892-1.

6 Test conditions

6.1 Black-panel/black-standard temperature

Unless otherwise specified, the black-panel temperature shall be 63 °C ± 3 °C. If a black-panel thermometer is used, then the type of thermometer, the way in which it is mounted on the specimen holder and the selected temperature of operation shall be stated in the exposure report.

If a water spray is used, the temperature requirement applies to the end of the dry period.

6.2 Relative humidity

Unless otherwise specified, the relative humidity shall be (50 ± 5) %.

NOTE 2 The relative humidity of the air as measured in the test chamber is not necessarily equivalent to the moisture content of the air very close to the specimen surface owing to the different temperatures of test specimens having different colours and thicknesses.

6.3 Spray cycle

The spray cycle used shall be as agreed between the interested parties, but should preferably be one of the cycles given in table 2.

Table 2 — Spray cycles

Duration of spraying min	Dry interval between spraying min
18 ± 0,5	102 ± 0,5
12 ± 0,5	48 ± 0,5

6.4 Cycles with dark periods

The conditions in 6.1 to 6.3 are valid for continuous presence of radiant energy from the source. More complex cycles may be programmed including dark periods that allow high relative humidities and the formation of condensate at elevated chamber temperatures.

Such programmes shall be given, with full details of the conditions, in the exposure report.

7 Procedure

7.1 Mounting the test specimens

Attach the specimens to the specimen holders in the equipment in such a manner that the specimens are not subject to any applied stress. Identify each test specimen by suitable indelible marking, avoiding areas to be used for subsequent testing. As a check, a plan of the test-specimen positions may be made.

If desired, in the case of specimens used to determine change in colour and appearance, a portion of each test specimen may be shielded by an opaque cover throughout the test. This gives an unexposed area adjacent to the exposed area for comparison. This is useful for checking the progress of the exposure, but the data reported shall always be based on a comparison with control specimens stored separately in the dark.

7.2 Exposure

Before placing the specimens in the test chamber, be sure the apparatus is operating under the specified conditions (see clause 6). Maintain these conditions throughout the exposure.

7.2.1 Mount the test specimens on the specimen frame both above and below the horizontal centreline of the source of radiation. To ensure uniform irradiation over the whole of the specimen surface, specimens shall be repositioned vertically in a sequence which will ensure that each specimen has

equivalent exposure periods in each location. When the exposure interval does not exceed 24 h, each specimen shall be located equidistant from the horizontal axis of the arc. For exposure intervals not exceeding 100 h, daily rotation of the specimens is recommended. Other methods of achieving uniform radiant exposure may be employed if mutually agreed on by the interested parties.

7.2.2 Replace filters after 2 000 h of use, or when pronounced discoloration or milkiness develops, whichever occurs first. Clean the filters, at intervals recommended by the manufacturer, with a clean, dry, non-abrasive cloth or towel, or with a solution of detergent and water followed by rinsing with clean water. It is recommended that filters be replaced on a rotating schedule in order to provide more uniformity over long periods of exposure. In such cases, replace the filters sequentially, in pairs, every 500 h. Monitor the age and position of the filter panes so that the oldest pair is removed each time.

7.3 Measurement of radiant exposure

If used mount the light-dosage measurement instrument so that the radiometer indicates the irradiance at the exposed surface of the test specimen.

The exposure interval shall be expressed in terms of incident spectral radiant energy per unit area of the exposure plane, in joules per square metre, for the passband selected.

7.4 Determination of changes in properties after exposure

These shall be determined as specified in ISO 4582.

8 Exposure report

Refer to ISO 4892-1.

Annex A
(normative)

Specifications for light source

Item	Specification
Type of light source	Open-flame type
Number of lamps	1
Arc voltage Arc current	AC voltage tolerance: 48 V to 52 V Set value: 50 V ± 1 V AC current tolerance: 58 A to 62 A Set value: 60 A ± 1,2 A
Carbon electrodes	a) Upper part, diameter and length: Ø (23 or 22) mm × 305 mm Lower part, diameter and length: Ø (13 or 15) mm × 305 mm b) Upper part, diameter and length: Ø (35 or 36) mm × 350 mm Lower part, diameter and length: Ø 23 mm × 350 mm or c) Upper part, diameter and length: Ø 36 mm × 410 mm Lower part, diameter and length: Ø 23 mm × 410 mm In all cases, the electrodes shall include cerium in the core and their surface shall be coated with a metal such as copper and be free from curvature, cracks, etc.

Annex B
(informative)

Information on filter elements used in carbon-arc lamps

Type 1:

Typical example: Corex 7058[1)]

Type 2:

Typical example: Pyrex 7740[1)]

Type 3:

Heat-resistant glass

Type 1 glass has been specified in most tests because of historical precedent. Types 2 and 3 may be used by mutual agreement between the interested parties. Type 1 filters transmit radiant energy below the cut-off wavelength of daylight that can cause degradation reactions that do not occur in outdooor exposures. Type 2 filters absorb this short-wavelength radiation that is not normally present in daylight. Type 3 filters are intended to represent the ultraviolet-transmission characteristics of single-thickness window glass. None of these filters significantly alters the spectral power distribution of the carbon arc to make it a better match to daylight in the ultraviolet region. Tests should not be conducted with unfiltered carbon arcs.

1) Corex 7058 and Pyrex 7740 are examples of suitable products available commercially. This information is given for the convenience of users of this part of ISO 4892 and does not constitute an endorsement by ISO of these products.

Annex C
(informative)

Typical test apparatus

A diagram of a typical test apparatus is given in figure C.1

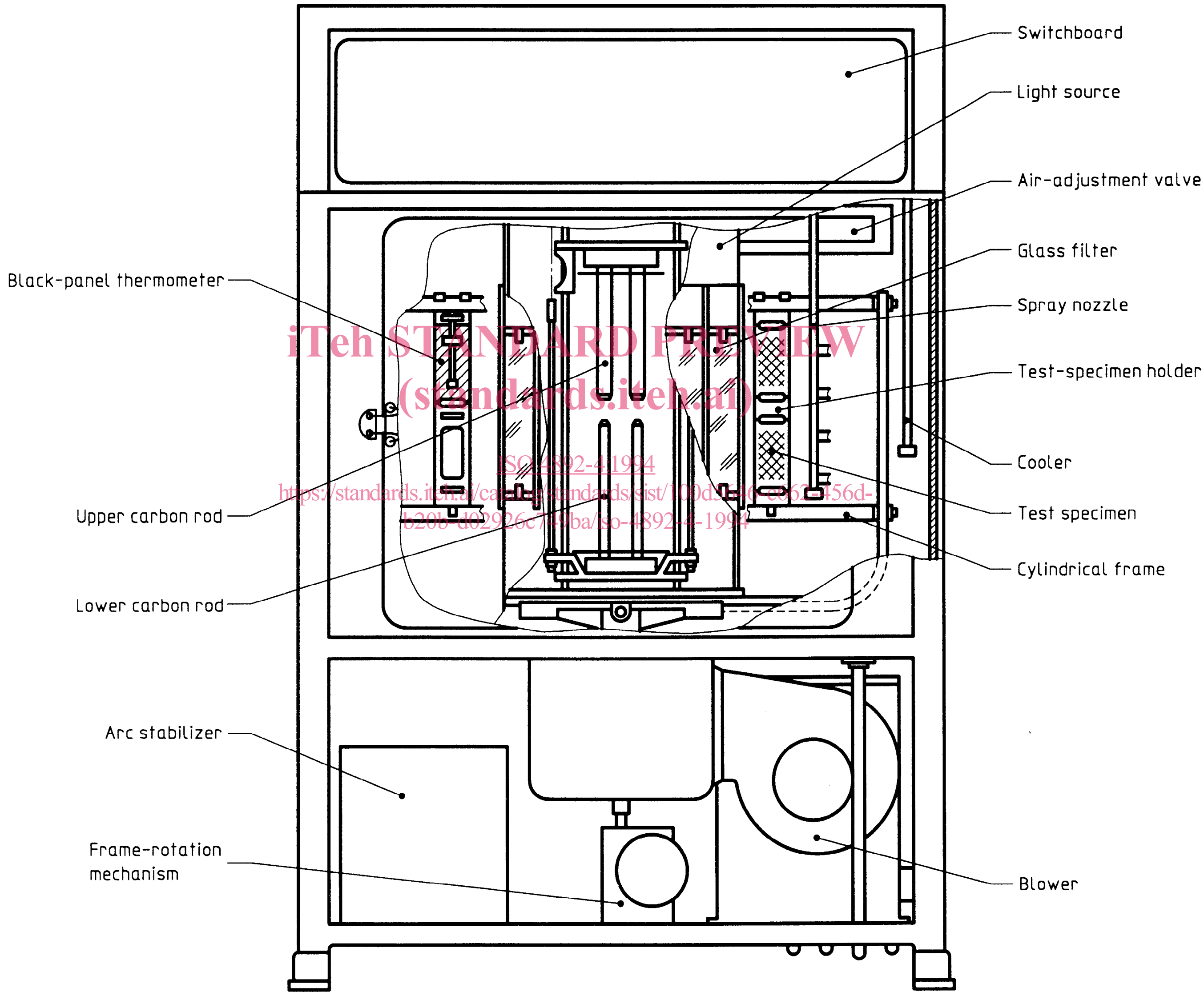

Figure C.1