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ISO 105-B10

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Textiles — Tests for colour fastness —

Part B10: **Artificial weathering — Exposure to filtered xenon-arc radiation**

Textiles — Essais de solidité des coloris —

Partie B10: Exposition aux intempéries artificielles — Exposition au rayonnement filtré d'une lampe à arc au xénon

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 105-B10 was prepared by Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC 1, *Tests for coloured textiles and colorants*.

ISO 105 consists of many parts designated by a part letter and a two-digit serial number (e.g. A01), under the general title *Textiles — Tests for colour fastness*. A complete list of these parts is given in ISO 105-A01.

Introduction

All four exposure conditions described in this part of ISO 105 are different from the method described in ISO 105-B04. This part of ISO 105 is not intended to replace ISO 105-B04 but to specify additional test options. Nevertheless, ISO/TC 38 might consider withdrawing ISO 105-B04 at a later date, after the textile industry has been able to achieve comprehensive experience using this part of ISO 105.

Textiles — Tests for colour fastness —

Part B10:
Artificial weathering — Exposure to filtered xenon-arc radiation

1 Scope

This part of ISO 105 specifies a procedure for exposing textiles to artificial weathering in xenon-arc apparatus, including the action of liquid water and water vapour, in order to determine the weather resistance of the colour of textiles. The exposure is carried out in a test chamber with a filtered xenon-arc light source simulating solar spectral irradiance according to CIE 85:1989, Table 4. The method can be used either for determining the colour fastness or the ageing behaviour of the textile under test. The method is also applicable to white (bleached or optically brightened) textiles.

2 Normative references

The following referenced documents are indispensable for the application 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 105-A01:2010, *Textiles — Tests for colour fastness — Part A01: General principles of testing*

ISO 105-A02, *Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour*

ISO 105-A05, *Textiles — Tests for colour fastness — Part A05: Instrumental assessment of change in colour for determination of grey scale rating*

ISO 139, *Textiles — Standard atmospheres for conditioning and testing*

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

ISO 9370, *Plastics — Instrumental determination of radiant exposure in weathering tests — General guidance and basic test method*

CIE[1)] Publication No. 15, *Colorimetry* (Third edition)

CIE Publication No. 51.2, *A method for assessing the quality of daylight simulators for colorimetry*

CIE Publication No. 85:1989, *Solar spectral irradiance*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
reference material
material of known performance

3.2
reference specimen
portion of the reference material that is to be exposed

1) Commission Internationale de l'Éclairage, CIE Central Bureau, Kegelgasse 27, A-1030 Vienna, Austria; http://www.cie.co.at.

3.3
control material
material which is of similar composition and construction to the test material and which is exposed at the same time for comparison with the test material

3.4
control specimen
portion of the control material that is to be exposed

3.5
radiant exposure
H
amount of the radiant energy, to which a specimen has been exposed, given by the equation

$$H = \int E \cdot \mathrm{d}t$$

where

E is the irradiance, in watts per square metre;

t is the exposure time, in seconds.

NOTE 1 H is expressed in joules per square metre.

NOTE 2 If the irradiance E is constant throughout the whole exposure time, the radiant exposure H is given simply by the product of E and t.

3.6
ageing behaviour
change in a property of a textile specimen during artificial weathering

NOTE One measure of ageing is the radiant exposure H in the wavelength range below 400 nm or at a specified wavelength, e.g. 340 nm. The ageing behaviour of a textile exposed to artificial weathering, or to artificial radiation, depends on the type of textile, the conditions of exposure of the textile, the property selected for monitoring the progress of the ageing process and the degree of change in this property.

3.7
ageing criterion
given degree of change in a selected property of the textile under test

NOTE The ageing criterion is specified or agreed upon.

4 Principle

A specimen of the textile to be tested is exposed to artificial radiation from a xenon-arc lamp with or without periodical wetting. The colour fastness is assessed by comparing the change in colour of the specimen using the grey scale.

The ageing behaviour is assessed by measuring the degree of change of a selected property, e.g. tensile strength, compared to an unexposed specimen, using the appropriate test method. The ageing criterion has to be agreed on by the interested parties and should preferably be one that is important for the practical end-use of the textile under test.

5 Apparatus and reference materials

5.1 Laboratory light source

5.1.1 General

The light source shall be one or more quartz-jacketed xenon-arc lamps, which emit radiation from about 270 nm in the ultraviolet through the visible spectrum and into the infrared. In order to simulate global solar radiation at the earth's surface as described in CIE 85:1989, Table 4, so-called daylight filters shall be used to remove short wavelength UV radiation <290 nm. In addition, filters to remove infrared radiation may be used to prevent unrealistic heating of test specimens that may cause thermal degradation not experienced during outdoor exposures.

NOTE Solar spectral irradiance for a number of different atmospheric conditions is described in CIE 85:1989. In accordance with other International Standards, this part of ISO 105 uses Table 4 in CIE 85:1989 as a benchmark for solar spectral irradiance.

The xenon-arc light source may be either air-cooled or water-cooled. Size, form and number of xenon-arc lamps will depend on the type of apparatus. An irradiance-controlled light source shall be used.

The variation in irradiance over the area covered by the specimens shall not exceed ±10 % of the mean. If this cannot be achieved, specimens shall be periodically repositioned to provide equivalent exposure periods in each location.

The characteristics of xenon-arc lamps and filters are subject to change during use due to ageing, and lamps and filters shall be replaced at suitable intervals. Furthermore, they are subject to change due to the accumulation of dirt and shall therefore be cleaned at suitable intervals. Follow the manufacturer's recommendations for replacement and cleaning of lamps and filters.

5.1.2 Spectral irradiance

Appropriate optical filters are used to reduce the xenon-arc emission in order to simulate daylight (CIE 85:1989, Table 4). The minimum and maximum levels for the relative spectral irradiance in the UV wavelength range of radiation are given in Table 1.

Table 1 — Relative spectral irradiance for xenon-arc with daylight filters[ab]

Spectral bandpass wavelength, λ nm	Minimum %[c]	CIE 85:1989, Table 4 %[de]	Maximum %[c]
λ ≤ 290	—	—	0,15
290 < λ ≤ 320	2,6	5,4	7,9
320 < λ ≤ 360	28,2	38,2	39,8
360 < λ ≤ 400	54,2	56,4	67,5

[a] Data in this table are the irradiance in the given bandpass expressed as a percentage of the total irradiance from 290 nm to 400 nm.

[b] The minimum and maximum data in this table are based on more than 100 spectral irradiance measurements for water-cooled and air-cooled xenon-arc instruments with daylight filters from different production lots and various ages (see ISO 4892-2), in accordance with the recommendations of the manufacturer. The minimum and maximum data are at least three sigma limits from the mean for all measurements.

[c] The minimum and maximum columns will not necessarily sum to 100 % because they represent the minimum and maximum for the data used. For any individual spectral irradiance, the calculated percentage for the bandpasses in this table will sum to 100 %. For any individual xenon-arc lamp with daylight filters, the calculated percentage in each bandpass shall fall within the minimum and maximum limits given. Test results can be expected to differ if obtained using xenon-arc devices in which the spectral irradiances differed by as much as that allowed by the tolerances. Contact the manufacturer of the xenon-arc device for specific spectral irradiance data for the xenon-arc and filters used.

[d] The data from Table 4 of CIE 85:1989 represent global solar spectral irradiance on a horizontal surface with an air mass of 1, column ozone of 0,34 cm at standard temperature and pressure (STP), 1,42 cm precipitable water vapour, and spectral optical depth of aerosol extinction of 0,1 at 500 nm. These data shall always serve as target values for xenon-arc lamps with daylight filters.

[e] For the solar spectrum represented by Table 4 in CIE 85:1989, the UV irradiance (290 nm to 400 nm) is 11 % and the visible irradiance (400 nm to 800 nm) is 89 %, expressed as a percentage of the total irradiance from 290 nm to 800 nm. These percentages of UV irradiance and visible irradiance on samples exposed in xenon-arc devices may vary due to the number and reflectance properties of specimens being exposed.

5.2 Test chamber

The design of the test chamber may vary, but it shall be constructed from inert material. The test chamber shall provide means for measurement and control of irradiance, black-standard or black-panel temperature, chamber air temperature and relative humidity. It shall also provide a system to provide humidification, a device for wetting the surface of the samples and a frame to carry specimen holders.

5.3 Radiometer

A radiometer for measuring irradiance either in the range from 300 nm to 400 nm, or at 340 nm, depending on the type of apparatus used. The radiometer shall comply with the requirements outlined in ISO 9370 and ISO 4892-1.

5.4 Temperature sensors

5.4.1 General

Temperature sensors are used both for measurement of the air temperature within the test chamber, and for the measurement of a black surface to control the surface temperatures of the samples during exposure.

5.4.2 Black-standard thermometer (BST) and black-panel thermometer (BPT)

Black-surface sensors are exposed to direct irradiance in a similar way as the samples. Settings for the insulated black-standard temperatures are given in Table 2. The paragraph after the note below Table 2 recommends settings for the uninsulated black-panel temperatures. Both surface temperatures have no relationship to each other. Therefore, the test results may not be comparable. Both types shall comply with the requirements outlined in ISO 4892-1. Generally, BST and BPT do not give the same readings.

In weathering devices where specimens are positioned in a flat plane in front of a light source, a black-standard thermometer shall be used.

NOTE 1 The BST differs from the BPT because the black plate of the BST is fixed on a thermally insulated mounting. The temperatures measured therefore correspond approximately to those measured on the exposed surface of the test specimen with a black or dark-coloured coating on a substrate of low thermal conductivity. The surface temperatures of light-coloured test panels will usually be lower.

NOTE 2 The surface temperature of a test specimen depends on a number of factors, including the amount of radiation absorbed, the amount of radiation emitted, thermal-conduction effects within the test specimen and heat transfer between the test specimen and the air, and between the test specimen and the sample holder, and cannot therefore be predicted with accuracy.

NOTE 3 At conditions used in typical exposures (no high irradiance), the temperature indicated by a BST typically will be approximately 2 K to 5 K higher than that indicated by a BPT.

NOTE 4 The black-standard thermometer is also called insulated black-panel thermometer. The black-panel thermometer is also called uninsulated black-panel thermometer.

5.4.2.1 Black-standard thermometer (BST)

The black-standard thermometer for measuring the black-standard temperature in the plane of the test specimens during the dry period shall consist of a plane (flat) stainless-steel plate with a thickness of about 0,5 mm to 1,0 mm. A typical length and width is about 70 mm by 40 mm. The surface of this plate facing the light source shall be coated with a black layer that has good resistance to ageing. The coated black plate shall absorb at least 90 % of all incident flux up to 2 500 nm. A platinum resistance sensor shall be attached in good thermal contact to the centre of the plate on the side opposite the radiation source. This side of the metal plate shall be attached to a 5 mm thick base-plate made of unfilled poly(vinylidene fluoride) (PVDF). A small space that is sufficient to hold the platinum resistance sensor shall be machined in the PVDF base-plate. The distance between the sensor and the recess in the PVDF plate shall be about 1 mm. The length and the width of the PVDF plate shall be sufficiently large to ensure that no metal-to-metal thermal contact exists between the black-coated metal plate and the mounting holder into which it is fitted. The metal mounts of the holder of the insulated black panel shall be at least 4 mm from the edges of the metal plate. Black-standard thermometers which differ in construction are permitted, as long as the temperature indicated by the alternative construction is within ±1,0 °C of that of the specified construction at all steady-state temperature and irradiance settings the exposure device is capable of attaining. In addition, time needed for the alternative black-standard thermometer to reach the steady state shall be within 10 % of the time needed for the specified black-standard thermometer to reach the steady state.

5.4.2.2 Black-panel thermometer (BPT)

The black-panel thermometer for measuring the black-panel temperature in the plane of the test specimens during the dry period shall consist of a plane (flat) metal plate that is resistant to corrosion. Typical dimensions are about 150 mm long, 70 mm wide and 1 mm thick. The surface of this plate facing the light source shall be coated with a black layer that has good resistance to ageing. The coated black plate shall absorb at least 90 % of all incident flux up to 2 500 nm. A thermally sensitive element shall be firmly attached to the centre of the exposed surface. This thermally sensitive element can be a black-coated stem-type bimetallic coil thermometer with a dial display or a resistance thermometer. The back of the metal panel shall be open to the atmosphere within the test chamber.

5.4.3 Chamber air-temperature sensor

The sensor for measuring the air temperature in the test chamber may either be a thermometer, a thermocouple or a thermal resistor. It shall be fixed in a position where the air temperature is similar to that in front of the samples, but shielded from the direct radiation from the xenon-arc lamp.