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Textiles — Tests for colour fastness —

Part B06:
Colour fastness to artificial light at high temperatures: Xenon arc fading lamp test

Textiles — Essais de solidité des teintures —

Partie B06: Solidité des teintures à la lumière artificielle à hautes températures: Lampe à arc au xénon

Reference number
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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 105-B06 was prepared by Technical Committee ISO/TC 38, *Textiles*, Sub-Committee SC 1, *Tests for coloured textiles and colorants*.

ISO 105 was previously published in 13 "parts", each designated by a letter (e.g. "Part A"), with publication dates between 1978 and 1985. Each part contained a series of "sections", each designated by the respective part letter and by a two-digit serial number (e.g. "Section A01"). These sections are now being republished as separate documents, themselves designated "parts" but retaining their earlier alphanumeric designations. A complete list of these parts is given in ISO 105-A01.

Annexes A, B and C form an integral part of this part of ISO 105.

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Introduction

This part of ISO 105 describes procedures, based on ISO 105-B02, for measuring colour fastness to light at high temperatures. However, whereas ISO 105-B02 uses black-panel thermometers (BPTs), development work with this method showed that black-panel thermometers were inconsistent in so far as thermal insulation is imperfect and the temperatures measured varied widely. Recently developed devices called black-standard thermometers (BSTs), which are properly insulated and which yield good reproducibility, have been included in this method.

This part of ISO 105 includes procedures for five sets of conditions which cover the range of devices used at present in different countries.

Several trials conducted in different countries showed similar results when performed with different test devices and consequently at different black-standard thermometer temperatures.

As the test temperatures differ, alterations will be made in future to yield closer figures. This can be achieved by changing the filtering system, the temperature of the test chamber or other parameters. The final aim is to have similar test temperatures for all devices used.

Textiles — Tests for colour fastness —

Part B06:
Colour fastness to artificial light at high temperatures: Xenon arc fading lamp test

1 Scope

1.1 This part of ISO 105 specifies a method for determining the resistance of colour of textiles of all kinds and in all forms to the action of artificial light representative of natural daylight and to the simultaneous action of heat. Of the five different sets of exposure conditions specified (see 4.3), four use D_{65} and the fifth a somewhat lower cut-off wavelength. The test method gives special consideration to the light and heat conditions which occur in the interior of a motor vehicle.

1.2 The method employs two sets of blue wool references. The results from the two sets of references may not be identical.

1.3 The five different sets of conditions specified are known to give similar, but not necessarily identical, results.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 105. 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 105 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 105-A01:1989, *Textiles — Tests for colour fastness — Part A01: General principles of testing.*

ISO 105-A02:1987, *Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour.*

ISO 105-B02:1988, *Textiles — Tests for colour fastness — Part B02: Colour fastness to artificial light: Xenon arc fading lamp test.*

ISO 105-B05:1988, *Textiles — Tests for colour fastness — Part B05: Detection and assessment of photochromism.*

3 Principle

A specimen of the textile is exposed to artificial light under prescribed conditions, along with blue wool references. The colour fastness is assessed by comparing the change in colour of the specimen with that of the references used or with the grey scale after the specimen has been exposed to a specified amount of radiant energy.

4 Reference materials and apparatus

4.1 Reference materials

Two sets of blue wool references may be used. The two sets of references are not interchangeable.

4.1.1 References 1 to 8

Blue wool references developed and produced in Europe are identified by the numerical designations 1 to 8. These references are blue wool cloths dyed with the dyes listed in table 1. They range from 1 (very low colour fastness) to 8 (very high colour fastness) so that each higher-numbered reference is approximately twice as fast as the preceding one (see table 1).

Table 1 — Dyes for blue wool references 5 to 8
(References 1 to 4 are not applicable to this test)

Reference	Dye (Colour Index designation)[1]
5	CI Acid Blue 47
6	CI Acid Blue 23
7	CI Solubilized Vat Blue 5
8	CI Solubilized Vat Blue 8

1) The Colour Index (Third edition) is published by the Society of Dyers and Colourists, P.O. Box 244, Perkin House, 82 Grattan Road, Bradford BD1 2JB, West Yorkshire, United Kingdom, and by the American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, North Carolina 27709, USA.

4.1.2 References L2 to L9

Blue wool references developed and produced in the United States are identified by the letter L followed by the numerical designation 2 to 9. These eight references are specially prepared by blending varying proportions of wool dyed with CI Mordant Blue 1 (Colour Index, Third edition, 43830) and wool dyed with CI Solubilized Vat Blue 8 (Colour Index, Third edition, 73801), so that each higher-numbered reference is approximately twice as fast as the preceding reference.

4.1.3 Humidity test control

The humidity test control is a red azoic dyed cotton cloth (see ISO 105-B02). This control is used only for those exposure conditions specified in 4.3.2.

4.2 Apparatus

4.2.1 Xenon arc lamp apparatus, either air-cooled or water-cooled.

The specimens and the references are exposed in one of two types of apparatus (see 4.2.1.1 and 4.2.1.2). The variation of the light intensity over the area covered by the specimens and references shall not exceed ± 10 % of the mean.

The distance from the surface of the specimen and that of the references to the lamp shall be the same.

4.2.1.1 Air-cooled xenon arc lamp apparatus (see annex A), consisting of the following elements:

a) **Light source**, in a **well ventilated exposure chamber.**

The light source shall consist of one or more xenon arc lamps, the number and size of which will depend on the type of apparatus used (see also A.1).

b) **Light filter**, placed between the light source and the specimens and references so that the ultraviolet spectrum is steadily reduced.

The transmission of the filter used shall be at least 90 % between 380 nm and 750 nm. For apparatus with absorbing filters, the transmission shall fall to 0 % between 310 nm and 320 nm (see A.1). For apparatus with absorbing and reflecting filters, a filter system shall be used so that the radiation at the specimen has a lower spectral cut-off value approximately equal to that of window glass (see A.1).

c) **Heat filter.**

The spectrum of the xenon arc contains an appreciable amount of infra-red radiation which shall be reduced by absorbing filters or a filter system consisting of an inner quartz cylinder with an infra-red reflecting layer, an outer quartz cylinder and a water jacket between the inner and outer quartz cylinders (see A.1).

d) **Humidity test control.**

The effective humidity at the surface of the specimens is low. In accordance with ISO 105-B02:1988, sub-clause 9.3, the colour fastness of the humidity test control shall be ⩾ 6, when obtained with blue wool references 5 to 8.

4.2.1.2 Water-cooled xenon arc lamp apparatus (see annex B), consisting of the following elements:

a) **Light source**, in a **well ventilated exposure chamber.**

The light source shall consist of a xenon arc lamp, the size of which will depend on the type of apparatus used (see also B.1.1).

b) **Light filters.**

1) For set of conditions No. 3: Inner and outer glass filters as specified in 4.3.3 to contain and direct the flow of cooling water. An inner filter of Pyrex (borosilicate) glass and an outer filter of clear (soda lime) glass shall be used so that the radiation at the specimen has a lower spectral cut-off value approximately equal to that of window glass (see also B.1.2).

2) For set of conditions No. 5: Cylindrical quartz inner filter and type "S" high-borate borosilicate glass outer filter that provide a UV cut-off at approximately 275 nm, which is somewhat below that of natural daylight, are used. This set is used to accelerate the rate of colour change (see also B.1.2).

c) **Heat filter.**

Distilled or deionized water circulating through the lamp assembly between the inner and outer glass filters, cooled by passage through a heat-exchange unit.

If a glass or water filter is used to eliminate excess infra-red radiation so as to meet the temperature conditions specified in 4.3, frequent cleaning shall be carried out to avoid unwanted filtering caused by dirt (see also B.1.4).

d) **Monitoring/controlling radiometer.**

Since the irradiance at the surface of the specimen may vary as a function of lamp intensity and lamp-to-specimen distance, uniformity of exposure shall be controlled by a monitoring radiometer which permits exposure to specified levels of irradiation (incident energy per unit area) at a point in the plane of the specimen rack (see C.1).

4.2.2 Opaque cardboard, of low sulfur content and free from fluorescent brightening agents, or **other thin opaque material**, partially covering the specimens and references.

4.2.3 Temperature sensors.

4.2.3.1 Black-standard thermometer (BST) (for sets of conditions 1 to 4).

The black-standard thermometer consists of a plain stainless-steel plate, measuring about 70 mm × 40 mm and with a thickness of about 0,5 mm, whose temperature is measured by a resistance thermometer, with good heat-conducting properties, fitted to the reverse side. The metal plate is fixed to a plastics plate so that it is thermally insulated. It is coated with a black layer which has an absorption of at least 95 %, even in the infra-red region.

4.2.3.2 Black-panel temperature-sensing device (for set of conditions No. 5).

The black-panel sensing device shall be a 70 mm × 150 mm × 0,95 mm stainless-steel panel to which is fastened a resistance thermometer element whose sensitive portion is centred both horizontally and vertically on the panel, the entire system being covered with a non-selective, infra-red-absorbing black finish. The black finish shall have at least 95 % absorbance. The side of the panel not facing the light source shall not be thermally insulated.

4.2.4 Grey scale for assessing change in colour, complying with the requirements of ISO 105-A02.

4.3 Exposure conditions — Apparatus with absorbing filters

4.3.1 Set of conditions No. 1

Air-cooled 4 500 W xenon arc lamp with four heat-absorbing filters and three window-glass filters, uniformly distributed on filter lantern

Specimens and references facing light source

Temperature in test chamber	45 °C ± 5 °C
BST temperature	115 °C ± 3 °C
Relative humidity in test chamber	(20 ± 10) % R.H.

4.3.2 Set of conditions No. 2

Air-cooled 1 500 W xenon arc lamp with four heat-absorbing filters and three window-glass filters, uniformly distributed on filter lantern

Specimens and references placed in upper half of sample holders, which turn 180° about their longitudinal axis after each revolution of the rack

Temperature in test chamber	35 °C ± 5 °C
BST temperature	82 °C ± 3 °C
Light fastness of red azoic dyed cotton control	⩾ 6

4.3.3 Set of conditions No. 3

Water-cooled 2 500 W, 3 500 W or 6 500 W xenon arc lamp with borosilicate inner filter and soda-lime outer filter

Specimens and references facing light source

Temperature in test chamber	70 °C ± 5 °C
BST temperature	100 °C ± 3 °C
Relative humidity in test chamber	(20 ± 10) % R.H.

4.3.4 Set of conditions No. 4

Lamp assembly comprising three air-cooled 4 500 W xenon arc lamps with fused-quartz inner filter with IR-reflecting layer, fused-quartz outer cylinder (with water between the inner filter and outer cylinder), and three additional sectional filters made of special UV glass (two filters) and window-glass (one filter)

Specimens and references facing light source

Temperature in test chamber	60 °C ± 5 °C
BST temperature	100 °C ± 3 °C
Relative humidity in test chamber	(20 ± 10) % R.H.

4.3.5 Set of conditions No. 5

Water-cooled 3 500 W or 6 500 W xenon arc lamp with quartz inner filter and type S high-borate borosilicate outer filter

Specimens and references facing light source

Alternating "light on" and "light off" periods (3,8 h light on/1 h light off) giving the conditions specified in table 2

5 Test specimens

The size of the test specimens will depend on the number of specimens to be tested and on the shape and dimensions of the specimen holders supplied with the apparatus.

5.1 In apparatus of the air-cooled type, an area of the textile measuring not less than 45 mm × 20 mm is usually used. The specimen may be a strip of fabric, yarns wound close together on a card or laid parallel and fastened to a card, or a mat of fibres combed and compressed to give a uniform surface and fastened to a card. Each exposed area and each unexposed area shall be not less than 20 mm × 20 mm.

The specimens can also be tested underlaid with the substrate material to be used or with other materials to be agreed upon. In this case, the maximum thickness of the underlaid material shall be 5 mm. The blue wool references shall **not** be underlaid with these materials (care shall be taken to avoid using foams which deteriorate chemically under the test conditions).

5.2 To facilitate handling, the specimens to be tested and the references may be mounted on one or more cards as indicated in figures 1 and 2.

5.3 In apparatus of the water-cooled type, specimen holders are fitted to take specimens measuring approximately 70 mm × 120 mm. When desired, specimens of different sizes to fit alternative sizes of specimen holder may be used. Specimens may be mounted on white cardboard, but L references shall always be exposed on a white cardboard backing.

5.4 The covers (see 4.2.2) shall make close contact with the surface of the unexposed areas of the specimens and the references, in order to give a sharp line of demarcation between exposed and unexposed areas, but shall not compress the specimen unnecessarily.

5.5 The specimens and references shall be of equal size and shape in order to avoid errors in assessment due to overrating the visual contrast between exposed and unexposed parts on the larger pattern as against the narrower references [see 7.1 c)].

5.6 When testing pile fabrics, the surface of the pile fabric shall be arranged in such a way that the specimens are the same distance from the light source as the references. Covers for the unexposed portions shall avoid surface compression.

6 Procedure

6.1 Adjustment of humidity (see 4.2.1.1 and 4.2.1.2)

6.1.1 Check that the apparatus is in good running order and that it is equipped with a clean xenon burner tube. (Follow the manufacturer's directions and see annex A and annex B.)

6.1.2 For set of conditions No. 2, place a portion of the humidity test control measuring not less than 45 mm × 20 mm, together with the blue wool references, on to a card, if possible in the middle area of the specimen holder (see 5.2).

Table 2 — Exposure cycle for set of conditions No. 5

Parameter	"Light on" period	"Light off" period
Irradiance level	0,55 W/m² ± 0,01 W/m² at 340 nm	—
Black-panel temperature	89 °C ± 2 °C	38 °C ± 2 °C
Dry-bulb temperature	63 °C ± 2 °C	38 °C ± 2 °C
Relative humidity	(50 ± 10) % R.H.	(95 ± 5) % R.H.
Conditioning-water temperature	63 °C ± 4 °C	40 °C ± 4 °C
Start the exposure at the beginning of a 3,8 h "light on" period (see C.2).		

6.1.3 Place the filled specimen holders on the specimen rack of the apparatus, with the holders supported both top and bottom and in proper vertical alignment. All spaces in the specimen rack not filled with specimens shall be filled with holders containing white cardboard.

6.1.4 Operate the apparatus continuously until a test is completed unless the lamp requires cleaning or the burner, outer filter or inner filter requires changing because it has reached the maximum number of hours of recommended usage.

6.1.5 For set of conditions No. 2, expose the partially covered strip of the humidity test control and the references simultaneously until a contrast between the exposed and unexposed portions equal to grade 4 on the grey scale is produced on the humidity test control.

6.1.6 For set of conditions No. 2, assess the colour fastness of the humidity test control at this stage and, if necessary, adjust the controls on the apparatus to give the selected exposure conditions. Check daily and, when necessary, re-adjust the controls to maintain the specified black-standard temperature and humidity [see 4.2.1.1 d) and 4.2.1.2 d)].

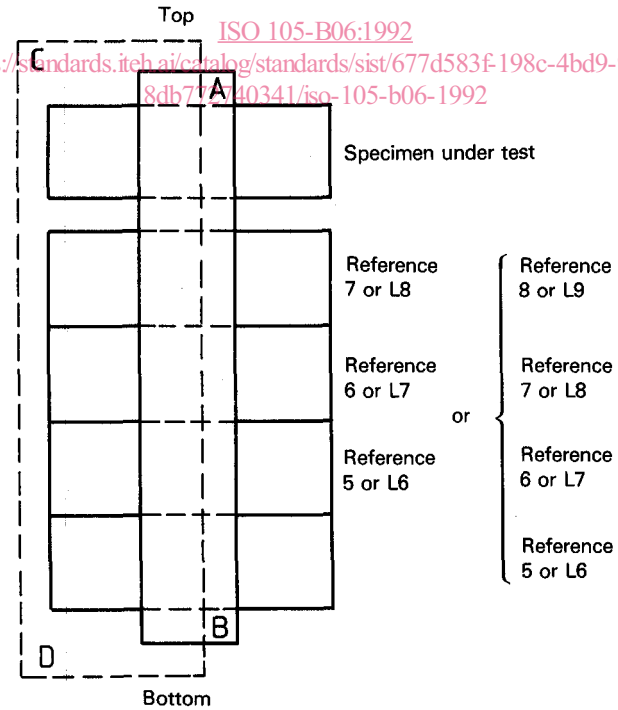
6.2 Exposure methods

Expose the specimen (or group of specimens) and the required references simultaneously under the desired conditions, in such a manner and for such time as is necessary to evaluate fully the colour fastness of each specimen relative to that of the references by progressively covering both the specimens and exposed references during the test (method 1).

6.2.1 Method 1 (End point determined by colour change in the specimen)

6.2.1.1 This method is considered the most satisfactory and shall be used in cases of dispute over the numerical rating. The basic feature is the control of the exposure periods by inspection of the **specimen** and, therefore, one set of references is required for each specimen under test.

6.2.1.2 Arrange the specimen to be tested and the references as shown in figure 1 with an opaque cover AB across the middle third of the specimen and references. Expose to the xenon arc light under the conditions enumerated in 4.2.1.1 and 4.2.1.2. Follow the effect of light by removing the cover periodically and inspecting the specimen.



AB: First opaque cover
CD: Second cover

Figure 1 — Mounting for method 1