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Textiles — Tests for colour fastness —

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

Textiles — Essais de solidité des coloris —

Partie B06: Solidité des coloris et vieillissement à la lumière artificielle à hautes températures: Essai avec 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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC 1, *Tests for coloured textiles and colorants*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 248, *Textiles*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 105-B06:1998), which has been technically revised. It also incorporates the Amendment ISO 105-B06:1998/Amd.1:2002.

The main changes compared to the previous edition are as follows:

— dates in normative references have been removed;

— flat array apparatus for testing has been introduced.

A list of all parts in the ISO 105 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Textiles — Tests for colour fastness —

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

1 Scope

This document specifies a method for determining the colour fastness and ageing properties of all kinds and forms of dyed and printed textiles and/or other organic substrates under the action of an artificial light source representative of natural daylight (D65), and under the simultaneous action of heat. Of the five different sets of exposure conditions specified (see 7.1.1), four use D65, and the other one uses a somewhat lower cut-off wavelength. The test method gives special consideration to the light and heat conditions that occur in the interior of a motor vehicle.

The five different sets of conditions using the different optical filter systems specified can produce different test results. Results from tests performed using different apparatus (instrument types) for the same set of conditions and optical filter system are not comparable because comparable performance has not been validated.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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, *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 105-B02, *Textiles — Tests for colour fastness — Part B02: Colour fastness to artificial light: Xenon arc fading lamp test*

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

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 Principle

4.1 Light fastness test

A specimen to be tested is exposed to artificial light under prescribed conditions, along with a set of blue wool references. The colour fastness shall be assessed by comparing the change in colour of the test specimen with that of the references used, or with the grey scale in accordance with ISO 105-A02, or by means of a colour measuring instrument in accordance with ISO 105-A05 after the specimen has been exposed to a specified amount of radiant energy.

4.2 Ageing test

A specimen to be tested, together with blue wool reference 6 (see ISO 105-B02), is exposed to artificial light under prescribed conditions. The change in colour of the specimen shall be evaluated on the grey scale in accordance with ISO 105-A02, or by means of a colour-measuring instrument in accordance with ISO 105-A05. Additional ageing criteria, such as mechanical properties, may also be evaluated.

Attention shall be paid to the principles for specifying and carrying out the tests, and for evaluating the test results according to ISO 105-A01.

5 Reference materials and apparatus

5.1 Reference materials

5.1.1 General

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

5.1.2 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

Reference	Dye (Colour Index designation)[3]
5	CI acid blue 47
6	CI acid blue 23
7	CI solubilized vat blue 5
8	CI solubilized vat blue 8
NOTE References 1 to 4 are not applicable to this test.	

5.1.3 References L2 and L4

Two blue wool references developed and produced in the United States are part of a series of eight references identified by the letter L followed by the numerical designation. These references are for the purpose of determining whether the xenon arc apparatus is operating within the desired range concerning set of conditions No. 5 (see D.4).

5.2 Apparatus

5.2.1 Exposure apparatus

The exposure apparatus consists essentially of a climatic test chamber made of a corrosion-resistant material and containing the optical light source, a filter system and holders for the test specimens.

5.2.2 Optical light source and filter system

One or more xenon arc lamps serve as the optical light source. The light for determining the hot light fastness shall be filtered. Optical light filter systems are used for this purpose. Both absorption filters and combinations of absorption and reflection filters shall be used according to Annex B and C, depending on the test instrument being used. Irrespective of the type of filtration, the conditions listed in Table 2 on the spectral energy distribution at the surface of the specimen shall be met.

Table 2 — Spectral irradiance

Wavelength nm	Relative irradiance[a] %	
	Set of exposure conditions	
	1, 2, 3 and 6	5
290	0	0,07
300	0,05	0,25
280 to 320	0,1	1,1 ± 0,5
320 to 360	3,0 ± 0,85	4,1 ± 1,17
360 to 400	$5,7^{+2,0}_{-1,3}$	$6,4^{+2,3}_{-1,5}$
400 to 520	$32,2^{+3,0}_{-5,0}$	27,3 ± 2,6
520 to 640	30 ± 3,0	27,2 ± 2,7
640 to 800	29,1 ± 6,0	$33,8^{+3,4}_{-8,8}$
< 800	100	100

[a] As a percentage of the total irradiance in the wavelength range up to 800 nm.

The radiant power shall be chosen to ensure that the conditions given in 7.1.1 are fulfilled.

The irradiance shall not deviate by more than 10 % from the average over the entire area occupied by the specimens and references.

Ageing causes the spectral energy distribution and irradiance to change during the service life of the xenon arc lamps and optical filters. Replacement of the lamps and filters in accordance with the manufacturers' instructions, allows the energy distribution and irradiance to be maintained. The irradiance can also be adjusted to keep it constant. Manufacturers who supply an exposure apparatus for use with this document should ensure that the conditions specified in 5.2 and 7.1.1 are met.

5.2.3 Radiometer for monitoring the exposure conditions

Since the irradiance at the surface of the specimen is affected by lamp intensity, lamp geometry and the specimen rack (lamp to specimen distance), repeatability and reproducibility of exposure shall be ensured by a monitoring radiometer which permits exposure to specified levels of irradiance (radiant flux per unit area) at a point in the plane of the specimen rack (see B.3 and C.3).

5.2.4 Temperature sensors

5.2.4.1 Black-standard thermometer (BST) (for sets of conditions 1 to 3)

The black-standard thermometer shall consist 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 thermal resistor, with good heat-conducting properties fitted to the reverse side. The metal plate is fixed to a plastic 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 infrared region.

5.2.4.2 Black-panel thermometer (BPT) (for sets of conditions 5 and 6)

The black-panel thermometer shall consist of a metal plate approximately 70 mm wide, 150 mm long, and 1 mm thick to which is fastened a thermal resistor whose sensitive portion is centred both horizontally and vertically on the panel, the entire system being covered with a non-selective, infrared 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.

5.2.5 Opaque cardboard

This shall be of low sulfur content and free from fluorescent brightening agents, or other thin opaque material, partially covering the specimens and references.

5.2.6 Grey scale for assessing change in colour

This shall be in accordance with ISO 105-A02.

5.2.7 Computerized spectral colour-measuring instrument

This is for evaluating the change in colour according to ISO 105-A05.

5.2.8 Polyester (PES) nonwoven fabric

This shall be at least 5 mm thick, with a mass per unit area of 100 g/m^2 ± 5 g/m^2, for placing under the specimens.

6 Preparation of specimens and exposure card

6.1 Test the specimens either with their own backing material or on a layer of polyester nonwoven fabric (see 5.2.8). Unless agreed otherwise, the thickness of the underlying material shall be at least 5 mm. The limit specified in 6.4 shall be observed. The blue wool references shall be placed on white card that does not contain fluorescent brightening agents.

6.2 Cut sections of at least 40 mm × 20 mm from flat materials and if necessary, attach them by their narrow edges to white card that does not contain fluorescent brightening agents. For pile goods, carpets and prints, cut the section to an appropriate size to include all colour components.

Wind yarns closely on to a card or mount on it in parallel lengths.

Form loose fibres into a nonwoven fabric or a fibrous web, of uniform thickness and surface and then mount on the white card.

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

6.3 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 8.1).

6.4 For thick specimens or those with an underlay, the distances from the light source to the surface of the specimens, the references and the black-standard thermometer or black-panel thermometer shall not differ by more than about 5 mm.

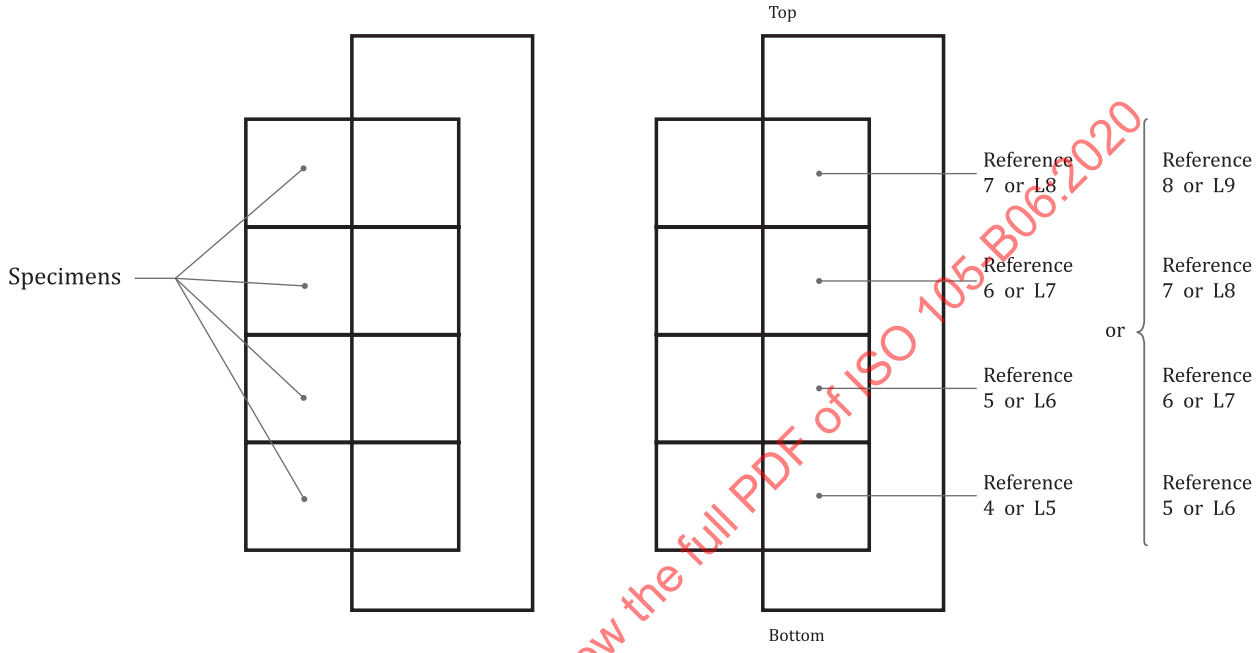

Figure 1 — Mounting for exposure method 2

7 Procedure

7.1 Exposure conditions

7.1.1 General

Five different sets of exposure conditions are permitted in terms of irradiance, black-standard temperature and test-chamber temperature. The specimens and references shall be exposed under one of the sets of temperature and humidity conditions given in Tables 3, 4 and 5 and according to Annex A.

Table 3 — Exposure conditions set Nos. 1 to 3

Condition	Set of conditions		
	3	1	2
IR component	normal	high	high
Black-standard temperature (°C)	100 ± 3	115 ± 3	90^{+0}_{-5}
Test chamber temperature (°C)	65 ± 3	48 ± 3	45^{+0}_{-5}
Test chamber relative humidity (%)	30 ± 5[a]	20 ± 10 no humidification	45 ± 10[a]
Irradiance (W/m^2)	45 to 162[b] 1,1 to 3,6[c]	70 to 90[b]	—

[a] If agreed between the interested parties the test may be run without using humidification unit.

[b] Broad-band measurement at 300 nm to 400 nm.

[c] Narrow-band measurement at 420 nm.

The test method set of conditions No. 1 may occasionally give rise to temperatures at the surface of the specimen that are considerably higher than those encountered in practice. In such cases, the method is unsuitable.

Table 4 — Exposure cycle under set of conditions No. 5

Condition	"Light on" period[a]	"Light off" period
Irradiance at 340 nm (W/m^2)	0,55 ± 0,01	—
Test-chamber temperature (°C)	63 ± 2	38 ± 2
Black-panel temperature (°C)	89 ± 2	38 ± 2
Test chamber relative humidity (%)	50 ± 10	95 ± 5
Temperature of conditioning water (°C)	63 ± 4	40 ± 4

[a] Exposure begins at the start of a 3,8 h "light on" period.

Table 5 — Exposure conditions set No. 6

Condition	Value
Irradiance (W/m^2)	162 (1 ± 10 %)[a]
Test-chamber temperature (°C)	50 ± 3
Black-panel temperature (°C)	89 ± 2
Test chamber relative humidity (%)	50 ± 5

[a] Broad-band measurement at 300 nm to 400 nm.

7.1.2 Fit the exposure cards or specimens into specimen holders and then into the testing apparatus, with all other specimen holders containing either white cards that are half-covered by an opaque cover with cutout, or exposure cards.

7.1.3 Carry out exposure under sets of conditions 1, 3, 5 and 6 in the non-turning mode, and that under set no. 2 in the turning mode. Interrupt exposure only for inspection purposes, in which case remove the specimen holder concerned from the apparatus.

7.2 Setting the exposure conditions for set No. 3

Fit the testing apparatus with clean xenon arc lamps and clean filters. The light-measuring system shall be calibrated according to the manufacturer's instructions.

Mount the exposure card with reference 6 (see 5.1.2) in a specimen holder and then in the apparatus, with all other specimen holders containing white cards that are half-covered by an opaque cover with cutout. Interrupt exposure only to inspect the exposure card. Continue exposure until a contrast corresponding to rating 3 on the grey scale (see 5.2.6) is reached on reference 6 (see 5.1.2). By experience, radiant exposure of (250 to 300) kJ/m^2 at 420 nm corresponding to (11 to 13,2) MJ/m^2 between 300 nm and 400 nm is necessary.

The contrast on reference 6 is best measured colorimetrically with a spectrophotometer. If faded to rating 3 of the grey scale, it corresponds to a value of 4,3 ± 0,4 DE* [Lab-Colour Space according to CIE, Commission Internationale de l'Eclairage (CIELAB)] for D65/10°. Before measuring, place the reference on unexposed card. When performing multiple exposures by method 3, inspect the specimens during the individual exposure periods, making sure that any deviations from the rated value are compensated during subsequent exposures, so that the sum of the deviations at the end of the series of exposures does not exceed ± 0,4 DE* (CIELAB). Compensation is achieved by adjusting the exposure time or radiant exposure. If agreed between the interested parties, the exposure may be continued until a contrast corresponding to rating 2 on the grey scale is reached on reference 6. This means twice the necessary radiant exposure.

NOTE 4,3 ± 0,4 DE* value for blue wool is the equivalent of a 3,4 ± 0,4 DE* value for the grey scale for assessing the change in colour. In other words, both equal a colour change of grey scale 3.

7.3 Exposure methods

7.3.1 General

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

7.3.2 Exposure Method 1 (end point determined by change in colour in the specimen)

This method is considered the most exact and should 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 blue wool references is required for each specimen under test.

NOTE This exposure method is not used by the automotive industry and has therefore been omitted from this document. For a detailed description, see ISO 105-B02:2014, 8.3.2.

7.3.3 Exposure Method 2 (end point determined by change in colour of reference)

Expose the specimens, half-covered by an opaque cover with cutout, and the references using the conditions given in 7.1.1. Monitor the effect of the light by frequently checking the references. Continue exposure until a contrast corresponding to rating 3 or rating 2 on the grey scale for assessing change in colour is observed between the exposed and unexposed parts of reference 6. Rating 3 on grey scale corresponds to a value of 3,4 ± 0,4 DE* (CIELAB) for D65/10°.

7.3.4 Exposure Method 3 (end point determined on the ageing test of 4.2)

Using exclusively set of exposure conditions No. 3 in 7.1.1, subject the specimens to a prescribed number of exposures in accordance with the specification in 7.2. Each exposure requires a new reference 6. The minimum specimen size for multiple exposures depends on the subsequent assessment method.

7.3.5 Exposure Method 4 (end point determined on radiant energy)

Expose the specimens under set of conditions No. 3, 5 or 6 (see 7.1.1) to a specified level of radiant exposure at a central wavelength of 340 nm, 420 nm or broad-band wavelength of 300 nm to 400 nm. The exact level of radiant exposure will depend on the material and the application and shall be agreed on by the interested parties.

8 Assessment of colour fastness to light

8.1 Remove all the covers from the test specimens and references thus revealing, depending on the method used, one or two areas which have been exposed for different times, together with at least one area which has not been exposed to light. After exposure, condition specimens for at least 24 h at a temperature of (20 ± 2) °C and a relative humidity of (65 ± 3) %. For each method compare, under suitable illumination (see ISO 105-A01:2010, Clause 15), the changes in each specimen with the relevant changes in the references as described below. Compare in each case the exposed area of the specimen with the unexposed area of the specimen or, alternatively, with a piece of the original specimen.

a) Assessment after testing by exposure method 2

   In this method, assess by comparing the change in colour of the specimen and the references or comparing the change in colour of the specimen with the grey scale. For both see 8.2.

b) Assessment after testing by exposure method 3

   On completion of the prescribed exposure periods, assess the specimens according to properties that need to be laid down. For example:

   — assessment of the surface (e.g. degree of lustre, cracking or blistering);

   — assessment of shade changes; visual assessment shall be performed only on the grey scale in accordance with ISO 105-A02. For colorimetric assessment, use ISO 105-A05, which leads to ratings that correspond to the grey scale ratings of ISO 105-A02;

   — testing physical properties such as tensile properties, abrasion and hardness.

c) Assessment after testing by exposure method 4

Record any change in colour (see 8.5). Visual comparisons may be made using the grey scale for assessing change in colour. If the specimens have a backing material, note if there is any increase in the stiffness of the backing.

8.2 Comparison of the changes in each specimen with the changes in the references or the grey scale may be facilitated by surrounding the specimen with a mask of neutral grey colour approximately midway between the lighter chips in grades 1 and 2 (approximately Munsell N5) and surrounding the references or the grey scale in turn with a similar mask of equal aperture.

8.3 To avoid misrating the colour fastness of the specimen due to photochromism, allow the specimen to condition in the dark at room temperature for 24 h before the colour fastness is assessed (see ISO 105-B05). If a specimen is suspected of photochromic behaviour, determine the photochromism according to ISO 105-B05. This shall be carried out under the exposure conditions specified in ISO 105-B02.

8.4 If the specimen is photochromic, the colour fastness rating shall include a P in parentheses with the rating obtained from the test for photochromism, for example 6 (P3-4) (see ISO 105-B05).

8.5 The term “change in colour” includes changes in hue, chroma, lightness or any combination of these characteristics (see ISO 105-A02:1993, Clause 3).

9 Test report

The test report shall include the following details.

a) a reference to this document, i.e. ISO 105-B06:2020;

b) exposure method 2:

   1) expressing either

      — the numerical light fastness rating (when using the references designated 1 to 8) or

      — the numerical rating for the colour change when using the grey scale;

   2) testing apparatus including optical filter type used;

   3) exposure method and conditions;

   4) construction of the test specimen (e.g. nature of underlay);

   5) deviations from this document;

   6) test date;

c) exposure methods 3 and 4:

   1) the numerical rating for the colour change by using the grey scale and/or values for physical properties;

   2) the number of exposures or exposure dose;

   3) testing apparatus including optical filter type used;

   4) exposure method and conditions;

   5) construction of the test specimen (e.g. nature of underlay);

   6) deviations from this document;

   7) test date.

Annex A
(normative)

Exposure methods and optical filter types

A.1 Exposure methods and optical filter types

The five sets of exposure conditions described in 7.1.1, Tables 3, 4 and 5, are typically achieved in the various testing apparatus as follows. Results from tests performed using different apparatus (instrument types) for the same set of conditions and filter system shall not be compared, as comparable performance has not been validated. Such tests in different instrument types may produce different test results.

Table A.1 — Exposure methods and optical filter types

Set of conditions	**3**				**1 and 2**	**5**	**6**
Filter system	7 IR	WG	BS/SL	RF320	4 IR + 3 WG	Q/BS	BS/SL
Type of apparatus	B	B, C	B, C	B	B	B, C, D	B, C
Optical filter types IR: infrared filter glass WG: window glass BS: borosilicate filter glass SL: soda lime filter glass RF320: reflection filter with cut-off at 320nm Q: quartz filter glass							
Apparatus (see appropriate annex) B Apparatus for determining colour fastness and ageing with air-cooled xenon arc lamps shall be in accordance with Annex B. C Apparatus for determining colour fastness and ageing with water-cooled xenon arc lamps shall be in accordance with Annex C. D In addition to Annex C, the guidance on performing the test according to the set of conditions No. 5 shall be applied in accordance with Annex D.							

Annex B
(normative)

Apparatus for determining colour fastness and ageing with air-cooled xenon arc lamps

B.1 Description and condition of use

B.1.1 Results from tests performed using different apparatus (instrument types) for the same set of conditions and filter system shall not be compared, as comparable performance has not been validated. Such tests in different instrument types may produce different test results. Prior to testing, instrument configuration shall be agreed to between interested parties to ensure compatibility with legacy test data.

B.1.2 The test apparatus used utilizes one or more air-cooled xenon arc lamps as the source of radiation. Different-type and different-size lamps operating in different wattage ranges are used in several of the different sizes and types of apparatus. In each of the various models of exposure apparatus, the diameter of the specimen rack or position of the tray, lamp size and lamp wattage has been established so that when the specimens are exposed in the holders, the irradiance at the face of the specimens is at the appropriate level.

B.1.3 The radiation system used consists of one or more xenon arc lamps, filter elements and the necessary accessories. For tests as described in this document, absorption filters or reflection-absorption filters are used in the different models of exposure apparatus so that the radiation at the specimen has a spectral cut-off value as defined in Table 2.

B.1.3.1 In rotating rack apparatus with absorption filters, the xenon arc lamp is surrounded by a lantern comprising infrared filter glasses, a combination of infrared filter glasses and window glasses, or only window glasses as well as an outer cylinder of special UV-glass. In flat array apparatus, absorption filters may be used to achieve similar spectral irradiance distribution for filters comparable to those specified in Table 2.

B.1.3.2 In apparatus with reflection-absorption filters, one or more xenon arc lamps are used. In rotating rack apparatus, there is an air-cooled heat absorber and the system is surrounded by a lantern comprising quartz filters with a special reflecting coating as well as an outer cylinder of special UV-glass. In flat array apparatus, reflection-absorption filters may be used to achieve similar spectral irradiance distribution for filters comparable to those specified in Table 2.

B.1.3.3 Replace xenon arc lamps and optical filters according to the apparatus manufacturer's recommendations.

B.1.4 The space between the xenon arc lamp(s) and the filtering device is cooled by a current of air. It is recommended that this cooling air be discharged outside the building.

B.2 Temperature and humidity control

B.2.1 Because of the sensitivity to temperature of some fabrics, accurate, close control of the test temperature is extremely important in tests made by the described procedures. The temperature is measured and, in some models of exposure apparatus, controlled using a black-standard thermometer

which is mounted on the revolving specimen rack or flat tray so that its surface is in the same relative position and subjected to the same influences as the test specimens.

B.2.2 A stream of air generated by a blower is directed through the test chamber and over the surface of the test specimens. The temperature of the air is typically automatically controlled by recirculating warm air from the test chamber mixed with cooler room air. It may be necessary to adjust and control the fan speed to meet both the specified black standard temperature and the specified test chamber temperature.

B.2.3 For certain apparatus, the specimen holders are mounted on a revolving rack at a fixed distance from a vertical lamp unit. Depending on the model of apparatus, the specimen holders may be mounted either vertically or inclined in the rack and the rack may be rotated at between 0,033 s^{-1} and 0,117 s^{-1} (2 r/min and 7 r/min) around the lamp unit. For set of conditions No. 2, the specimen holders may be turned 180° about their longitudinal axis after each revolution of the rack.

B.2.4 Apparatus for use in this method are equipped with a means of controlling the length of exposure. Some types of apparatus are additionally equipped with a radiometer (broad-band UV: 300 nm to 400 nm) designed to switch off the apparatus as soon as a given radiant exposure has been achieved.

B.3 Monitoring/controlling radiometer

A radiometer mounted on or near the test specimen area can be used in this method. A radiometer using a broad bandpass filter restricting measurement to the ultraviolet spectral region between 300 nm and 400 nm has been used satisfactorily. Filter radiometers capable of integrating irradiance with respect to time are satisfactory (see C.3).

The calibration of the radiometer shall be certified by the manufacturer for a specified time interval when used in accordance with this document.

Annex C
(normative)

Apparatus for determining colour fastness and ageing with water-cooled xenon arc lamps

C.1 Description and conditions of use

C.1.1 The test apparatus used utilizes a water-cooled xenon arc lamp as the source of radiation. While all of the xenon arc lamps used are of the same general type, different-size lamps operating in different wattage ranges are used in several of the different sizes and types of apparatus. In each of the various models of exposure apparatus, the diameter of the specimen rack, lamp size and lamp wattage has been established so that, when the specimens are exposed in the holders, the irradiance at the face of the specimen is at the appropriate level.

C.1.2 The xenon arc lamp typically consists of a xenon arc lamp, inner glass filter, outer glass filter and the necessary accessories. For colour fastness tests, a borosilicate glass inner filter and a soda-lime glass outer filter are commonly used so that the radiation at the specimen has a spectral cut-off value as defined in Table 2 (for set of conditions No. 5 according to Annex D). In some cases, there is an additional outer cylindrical filter comprising three partial covers of window glass. Other filters may be used provided they meet the relative irradiance and spectral cut-off specified in Table 2 and the use of such filters is reported. Follow the manufacturer's instructions for filter replacement. When applicable, because of transmission change (solarization), outer filters should be discarded after 1 000 h or after 2 000 h dependent on the type of filter used and inner filters should be discarded after 400 h of use or 1 000 h of use dependent on the type of filter used. Because of a drop in intensity with continued use, xenon arc lamps should be discarded when the irradiance, listed in Tables 3, 4 and 5, is no longer achievable by automatic control or manual adjustment.

C.1.3 All xenon arc exposure apparatus are equipped with suitable starters, reactance transformers and indicating and control equipment for either manually or automatically controlling the wattage of the lamp. In manually controlled units, the wattage of the lamp may require periodic adjustment to maintain the irradiance, listed in Tables 3, 4 and 5.

C.1.4 To cool the lamp, distilled or deionized water is circulated through the lamp assembly as specified by the instrument manufacturer. To prevent contamination and minimize the formation of deposits, the water may be purified by the use of a mixed-bed deionizer just ahead of the lamp. The recirculated lamp water is cooled without contamination by means of a heat-exchange unit.

C.2 Temperature and humidity control

C.2.1 Because of the sensitivity to temperature of some fabrics, accurate, close control of the test temperature is extremely important in tests made by this procedure. The temperature is measured and controlled using either a black-standard thermometer or a black-panel thermometer, which is mounted on the revolving specimen rack so that its surface is in the same relative position and subjected to the same influences as the test specimens.

C.2.2 The exposure apparatus is enclosed in an insulated cabinet to minimize the effects of any variation in room temperature. A ventilation system provides a continuous stream of air through the test chamber and over the test specimens. The temperature of the air is automatically controlled by re-circulating warm air from the test chamber mixed with cooler room air. It may be necessary to adjust and