BRITISH STANDARD

BS EN ISO 105-B06:2004

Incorporating Amendment No. 1 to BS ISO 105-B06:1998 (renumbers the BS ISO as BS EN ISO 105-B06:2004)

Textiles — Tests for colour fastness —

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

The European Standard EN ISO 105-B06:2004 has the status of a British Standard

ICS 59.080.01

British Standards

National foreword

This British Standard is the official English language version of EN ISO 105-B06:2004. It is identical with ISO 105-B06:1998.

The start and finish of text introduced or altered by ISO amendment 1 is indicated in the text by tags A1 A1.

The UK participation in its preparation was entrusted to Technical Committee TCI/81, Colour fastness and colour measurement of textiles, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled "International Standards Correspondence Index", or by using the "Search" facility of the *BSI Electronic Catalogue* or of British Standards Online.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

This British Standard, having been prepared under the direction of the Materials and Chemicals Sector Policy and Strategy Committee, was published under the authority of the Standards Policy and Strategy Committee on 12 December 2002

Summary of pages

This document comprises a front cover, an inside front cover, the EN ISO title page, the EN ISO foreword page, the ISO title page, page ii, pages 1 to 16, an inside back cover and a back cover.

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EUROPEAN STANDARD

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EUROPÄISCHE NORM

EN ISO 105-B06

April 2004

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English version

Textiles - Tests for colour fastness - Part B06: Colour fastness and ageing to artificial light at high temperatures: Xenon arc fading lamp test (ISO 105-B06:1998, including Amendment 1:2002)

Textiles - Essais de solidité des teintures - Partie B06: Solidité et vieillissement des teintures à la lumière artificielle à hautes températures: Essai avec lampe à arc au Xénon (ISO 105-B06:1998, Amendement 1:2002 inclus)

Textilien - Farbechtheitsprüfungen - Teil B06: Farbechtheit und Alterung gegen künstliches Licht bei hohen Temperaturen: Prüfung mit der Xenonbogenlampe (ISO 105-B06:1998, einschließlich Änderung 1:2002)

This European Standard was approved by CEN on 9 February 2004.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Ref. No. EN ISO 105-B06:2004 E

Foreword

The text of ISO 105-B06:1998, including Amendment 1:2002, has been prepared by Technical Committee ISO/TC 38 "Textiles" of the International Organization for Standardization (ISO) and has been taken over as EN ISO 105-B06:2004 by Technical Committee CEN/TC 248 "Textiles and textile products", the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2004, and conflicting national standards shall be withdrawn at the latest by October 2004.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Endorsement notice

The text of ISO 105-B06:1998, including Amendment 1:2002, has been approved by CEN as EN ISO 105-B06:2004 without any modifications.

INTERNATIONAL STANDARD

ISO 105-B06

Second edition 1998-11-01

Incorporating amendment 1:2002

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 teintures —

Partie B06: Solidité et vieillissement des teintures à la lumière artificielle à hautes températures: Essai avec lampe à arc au xénon

Reference number
ISO 105-B06:1998(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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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

ISO 105 was previously published in thirteen “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.

This second edition cancels and replaces the first edition (ISO 105-B06:1992), which has been technically revised.

Annexes A to D form an integral part of this part of ISO 105.

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 part of ISO 105 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. [A1] Of the five different sets of exposure conditions specified (see 6.1), four use D65, and the other one uses a somewhat lower cut-off wavelength [A1]. The test method gives special consideration to the light and heat conditions that occur in the interior of a motor vehicle.

[A1] The five different sets of conditions specified are known to give similar but not necessarily identical results. [A1]

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 105. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 105 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 105-A01:1994, *Textiles — Tests for colour fastness — Part A01: General principles of testing.*

ISO 105-A02:1993, *Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour.*

ISO 105-A05:1996, *Textiles — Tests for colour fastness — Part A05: Instrumental assessment of change in colour for determination of grey scale rating.*

ISO 105-B02:1994, *Textiles — Tests for colour fastness — Part B02: Colour fastness to artificial light: Xenon arc fading lamp test.*

ISO 105-B05:1993, *Textiles — Tests for colour fastness — Part B05: Detection and assessment of photochromism.*

3 Principle

3.1 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 is 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.

3.2 Ageing test

A specimen to be tested, together with reference 6 (see ISO 105-B02), is exposed to artificial light under prescribed conditions. The change in colour of the specimen is 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.

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

4 Reference materials and apparatus

4.1 Reference materials

Two different 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

Reference	Dye (colour index designation)[a]
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.	
[A] 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 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).

4.2 Apparatus

4.2.1 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.

4.2.2 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 are used (see annexes B and C). 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	
	[A1] 1, 2, 3 and 6 [A1]	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	[A1] 32,2 $^{+3,0}_{-5,0}$ [A1]	27,3 ± 2,6
520 to 640	[A1] 30,0 + 3,0 [A1]	27,2 ± 2,7
640 to 800	29,1 ± 6,0	33,8 + 3,4 − 8,8
[A1] < 800 [A1]	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 6.1 are fulfilled.

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

NOTE 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 part of ISO 105 should ensure that the conditions specified in 4.2 and 6.1 are met.

4.2.3 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 (incident energy per unit area) at a point in the plane of the specimen rack (see B.3 and C.3).

4.2.4 Temperature sensors

4.2.4.1 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 3 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.

4.2.4.2 Black-panel thermometer (BPT) [A1] (for sets of conditions Nos. 5 and 6) [A1]

The black-panel thermometer shall consist of a metal plate at least 70 mm 3 150 mm 3 1 mm 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.

4.2.5 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.

4.2.6 Grey scale for assessing change in colour

This shall be in accordance with ISO 105-A02.

4.2.7 Computerized spectral colour-measuring instrument

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

4.2.8 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.

5 Preparation of specimens and exposure card

5.1 Test the specimens either with their own backing material or on a layer of polyester nonwoven fabric (see 4.2.8). Unless agreed otherwise, the thickness of the underlying material shall be at least 5 mm. The limit specified in 5.4 shall be observed. The blue wool references shall be placed on white card that does not contain fluorescent brightening agents.

5.2 Cut sections of at least 40 mm 3 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 sections somewhat larger.

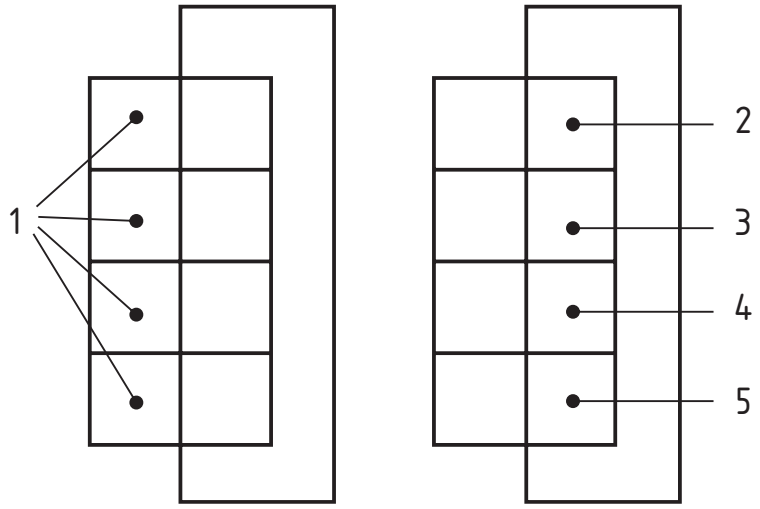
Wind yarns closely on to a card or mount on it in parallel lengths.

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.

5.3 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 7.1).

5.4 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.



Key

1 Specimens
2 Reference 7 or L8
3 Reference 6 or L7
4 Reference 5 or L6
5 Reference 4 or L5

or { Reference 8 or L9 / Reference 7 or L8 / Reference 6 or L7 / Reference 5 or L6

Figure 1 — Mounting for exposure method 2

6 Procedure

6.1 Exposure conditions

[A1] Five different sets of exposure conditions are permitted in terms of irradiance, black-standard temperature and test-chamber temperature. The specimens and references are exposed under one of the sets of temperature and humidity conditions given in Tables 3, 4 and 5. [A1]

Table 3 — Exposure conditions set Nos. 1 to 3

Condition	Set of conditions		
	3	1	2
IR component	normal	high	high
Black-standard temperature in °C	100 ± 3	115 ± 3	90 + 0 / 2 5
Test chamber temperature in °C	65 ± 3	48 ± 3	45 + 0 / 2 5
Relative humidity in test chamber %	30 ± 5[a]	20 ± 10 no humidification	45 ± 10[a]
Irradiance in W/m^2	[A1] 45 to 162[b] [A1] [A1] 1,1 to 3,6[c] [A1]	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.

NOTE 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

Parameter	"Light on" period[a]	"Light off" period
Irradiance	0,55 W/m^2 ± 0,01 W/m^2 at 340 nm	–
Test-chamber temperature °C	63 ± 2	38 ± 2
Black-panel temperature °C	89 ± 2	38 ± 2
Relative humidity in test chamber %	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 (see annex D).

〚A1〛 Table 5 — Exposure conditions set No.6

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

[a] Broadband measurement at 300 nm to 400 nm.

〈A1〉

6.1.1 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.

6.1.2 Carry out exposure under sets of conditions 〚A1〛 1, 3, 5 and 6 〈A1〉 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.

6.2 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 4.1.1) 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 4.2.6) is reached on reference 6 (see 4.1.1). 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 〚A1〛 4,3 ± 0,4 DE* (CIELAB) 〈A1〉 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 dose. If agreed between the

interested parties, the exposure may be continued until a contrast corresponding to rating 2 on the gray scale is reached on reference 6. This means twice the necessary radiant exposure.

[A1] 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. [A1]

6.3 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 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.

6.3.1 Exposure method 1 (end point determined by colour change 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 standard. For a detailed description see 7.2.1 of ISO 105-B02:1994.

6.3.2 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 6.1. 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°.

6.3.3 Exposure method 3 (end point determined on the ageing test of 3.2)

[A1] Using exclusively set of conditions No. 3 in 6.1, subject to specimens to a prescribed number of exposures in accordance with the specification given in 6.2 [A1]. Each exposure requires a new reference 6. The minimum specimen size for multiple exposures depends on the subsequent assessment method.

6.3.4 Exposure method 4 (end point determined on radiant energy)

Expose the specimens under set of conditions [A1] No. 3, 5 or 6 (see 6.1) [A1] 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.

7 Assessment of colour fastness to light

7.1 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-A01:1994, clause 14), 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 7.2.

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

NOTE any change in colour (see 7.5). 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.

7.2 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.

7.3 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 photochromism according to ISO 105-B05. This may be carried out under the exposure conditions specified in ISO 105-B02.

7.4 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).

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

8 Test report

The test report shall include the following details.

a) reference to this part of ISO 105, i.e. ISO 105-B06:1998;

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;

3) exposure method and conditions;

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

5) deviations from this part of ISO 105;

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;

4) exposure method and conditions;

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

6) deviations from this part of ISO 105;

7) test date.

Annex A
(normative)

Exposure methods

[A1] The five sets of exposure conditions described in 6.1, Tables 3, 4 and 5, are typically achieved in the various testing apparati as follows. Other filters that will provide the appropriate spectra as defined in Table 2 may also be used. [A1]

[A1]

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	B	C, D	C

Key
IR: infrared filter glass
WG: window glass
BS: borosilicate filter glass
SL: soda lime filter glass
RF320: reflection filter with cut-off at 320 nm
Q: quartz filter glass
B: apparatus for determining colour fastness and ageing with air-cooled xenon lamps
C: apparatus for determining colour fastness and ageing with water-cooled xenon lamps
D: information on performing the test accordance with set of conditions No. 5.

[A1]

Annex B
(normative)

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

B.1 Description and conditions of use

B.1.1 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, 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.1.2 The radiation system used consists of one or more xenon burner tubes, filter elements and the necessary accessories. For tests as described in this part of ISO 105, 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.1.2.1 In apparati with absorption filters the xenon arc lamp is surrounded by a lantern comprising infrared filter glasses or a combination of infrared filter glasses and window glasses or only window glasses as well as an outer cylinder of special UV-glass.

B.1.2.2 In apparati with reflection-absorption filters one or more xenon arc lamps are used. Depending on the model of apparatus there is an air- or water-cooled heat absorber and the system is surrounded either by a lantern comprising quartz filters with a special reflecting coating as well as an outer cylinder of special UV-glass, or by an inner quartz cylinder with an infrared reflecting coating and an outer quartz cylinder with a water jacket in between as well as an outer cylindrical filter comprising three partial covers of window glass.

B.1.2.3 Because of the drop in intensity with continued use, the xenon burner tube(s) shall be discarded after 1 500 h of use or when the irradiance listed in Table 3 is no longer achievable in apparati with automatic control of irradiance in specimen area. In apparati with more than one xenon arc lamp, the burners shall be exchanged in rotation.

Because of transmission changes (solarization) of the infrared and window glass filters the oldest filter in the lantern shall be replaced every 500 h.

B.1.3 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 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, with one exception, 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 The specimen holders are mounted on a revolving rack at a fixed distance from the 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^{21} and 0,114 s^{21} (2 rpm and 7 rpm) 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 is 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 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 part of ISO 105.

Annex C
(normative)

Apparatus used for determining colour fastness and ageing with water-cooled xenon 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 ⟦A1⟩ The xenon arc lamp typically consists of a xenon burner tube, 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, see annex D). Other filters may be used providing 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 shall 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 burners should be discarded when the irradiance, listed in Table 3, 4, 5 or 6 is no longer achievable by automatic control or manual adjustment. ⟨A1⟩

C.1.3 All xenon arc exposure apparati 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 ⟦A1⟩ Table 3, 4 and 5. ⟨A1⟩

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 control the fan speed to meet both the specified black-panel temperature and the specified test chamber temperature.

C.2.3 The specimen holders are supported by a vertical or inclined cylindrical frame or rack which is rotated at 0,016 s^{21} (1 rpm) around the lamp which is centred both horizontally and vertically with respect to the exposure area in the sample holders (see C.1.)

C.2.4 Apparatus for use in this method is equipped with a countdown timer for controlling the length of exposure. Some apparatus is also equipped with a light monitor designed to switch off the apparatus as soon as a given radiant exposure has been achieved.

C.3 Monitoring/controlling radiometer

A radiometer using a narrow-bandpass interference filter restricting measurement to the UV spectral region has been used satisfactorily. It consists of a sensor employing a photodetector and an interference filter with a central-wavelength tolerance no greater than 2 nm, and a half-bandwidth no greater than 20 nm.

〚A1〛 Single- or multiple-filter radiometers capable of measuring, recording, controlling and/or integrating irradiance with regard to time are satisfactory. A radiometer using a broad band-pass filter retracting measurement to the UV region (300 nm to 400 nm) is also satisfactory. 〚A1〛

For monitors designed to automatically maintain a constant level of irradiance, exposures of equal time should provide equivalent radiant exposure, Q, which may be calculated by the following formula:

$$Q = E \times 3{,}6 \times t$$

where

Q is the radiant exposure, expressed in kilojoules per square metre;

E is the irradiance, expressed in watts per square metre (or joules per square-metre-second);

t is the time, expressed in hours;

3,6 is a conversion factor expressed in kiloseconds per hour.

Single-filter radiometers equipped with a presettable countdown integrator calibrated in kilojoules per square metre, designed for use with the exposure apparatus, can be used to terminate the test when the specimens have received the required level of radiant exposure.

The radiometer shall have means, provided by the manufacturer, for checking the calibration, or calibration shall be certified by the manufacturer for a specified time interval when the apparatus is used in the manner described herein.

Annex D
(normative)

Information on performing the test according to set of conditions No. 5

D.1 Setting up the apparatus

To ensure repeatability of tests, maintain and calibrate the apparatus to the manufacturer's specifications.

Remove and cap the specimen spray unit. Although the specimen spray can be turned off by means of a switch on the control panel, it is recommended that the specimen spray assembly be removed and the pipe capped to prevent accidental spraying of the test specimens.

Turn off the rack spray unit with the valve provided. Fit the xenon arc burner with a quartz inner filter and type "S" high-borate borosilicate outer filter. Other filters may be used providing they meet the relative irradiance and spectral cut-off value as specified in Table 2 and the use of such filters is reported.

Select a suitable programme or set the operation switches and thumbwheels (on those instruments so equipped) to provide the following cycle and conditions.

Wattage adjustment:	automatic	
Countdown switch:	irradiation	
Lamp ignition:	on	
Fixed-air valve:	off	
Humidifier:	on	
Water heater:	on	
Air heater:	on	
Specimen spray:	off	
Rack spray:	off	
Cycle selector light/dark	Light period	Dark period
Automatic irradiance	0,55 W/m^2 at 340 nm	
Black panel temperature	89 °C	38 °C
Wet bulb depression	13 °C	0 °C
Conditioning-water temperature	63 °C	40 °C
Light/dark cycle	3,8 h	1 h

Set the temperature of the lamp cooling water at 60 °C and the high-temperature cut-out at 70 °C. Adjust the temperature as necessary to provide sufficient lamp cooling but prevent condensation from forming on the lamp assembly.

NOTE It may be necessary to adjust the fan speed to meet both the specified black-panel temperature and the specified dry-bulb temperature.

Inspect the wet-bulb wick (if the instrument uses this method of humidity control) weekly, and replace it if it is discoloured or mineral deposits are observed.

D.2 Usable positions on the rack

On two-tier inclined racks with eight specimen locations, exclude the extreme top and bottom locations.

D.3 Positioning of references

Place the references in the centre of the rack on either side of the black-panel thermometer.

D.4 Use of references for statistical process control

Expose an L2 blue wool reference daily, from Monday to Thursday, to 37,6 kJ/m^2 at 340 nm. This exposure should produce a colour change equivalent to between step 2 and step 1-2 on the grey scale or to a DE* (CIELAB) for D65/10° value equal to the value and tolerance indicated on the certificate issued for the current lot of the blue wool reference material when measured instrumentally. Laboratories that do not operate on a seven-day basis shall, on Friday, expose an L4 reference to 112,8 kJ/m^2 at 340 nm in order to span the weekend. This exposure should produce a colour change equivalent to step 2 on the grey scale or an E* value equal to the value and tolerance indicated on the certificate issued for the current lot of the blue wool reference material when measured instrumentally.

Ensure that all blue wool standards used in condition No. 5 are entered into the machine at the end of a dark cycle.

If, after exposure to the level of irradiation specified, the respective blue wool references do not produce the given colour change, do not resume the test until the reason has been determined and the problem resolved.

A chart recording the variation in colour change of the reference from day to day can be used to demonstrate process capability.

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