INTERNATIONAL STANDARD

ISO 105-B06

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

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.

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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

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. Of the four different sets of exposure conditions specified (see 6.1), three use D65, and the fourth 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 four different sets of conditions specified are known to give similar but not necessarily identical results.

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	
	1, 2 and 3	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 ± 3,1	27,3 ± 2,6
520 to 640	$30,0^{+3,0}_{-5,1}$	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 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 × 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) (for set of conditions No. 5)

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

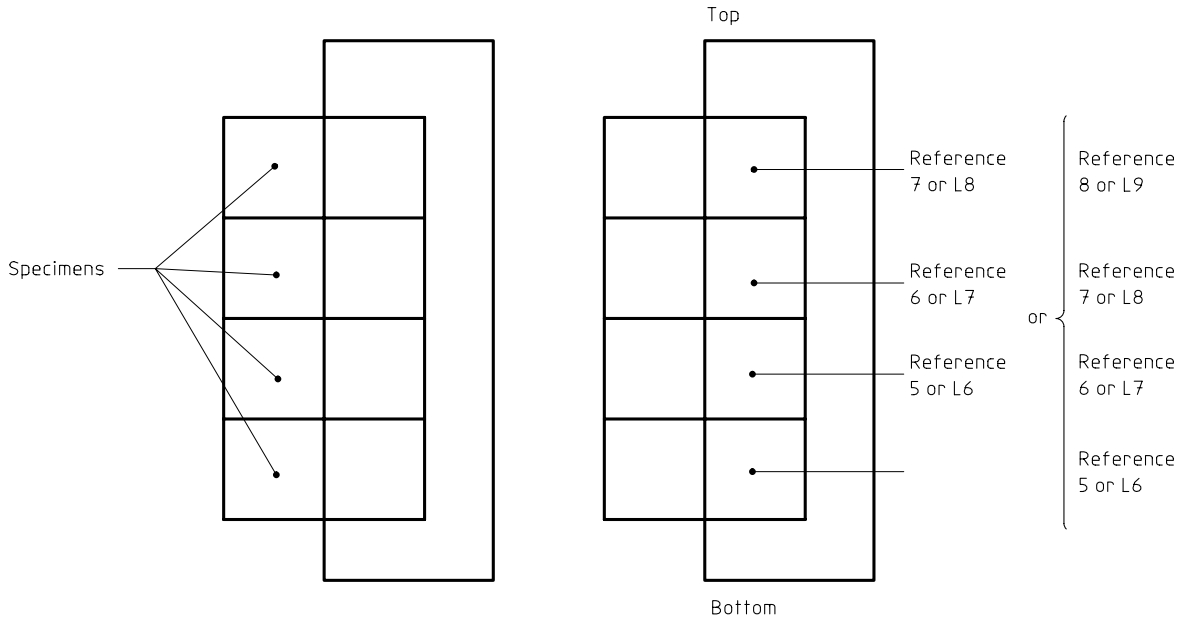

Figure 1 — Mounting for exposure method 2

6 Procedure

6.1 Exposure conditions

Four 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 and 4.

Table 3 — Exposure conditions set Nos. 1 to 3

Condition	Set of conditions		
	3	1	2
Black-standard temperature in °C	100 ± 3	115 ± 3	90 + 0 − 5
Test chamber temperature in °C	65 ± 3	48 ± 3	45 + 0 − 5
Relative humidity in test chamber %	30 ± 5[a]	20 ± 10 no humidification	45 ± 10[a]
Irradiance in W/m^2	45 to 60[b] 1,1 to 1,4[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.

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).

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 1, 3 and 5 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 3,4 ± 0,4 DE* (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 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.

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)

Using set of exposure conditions No. 3 in 6.1, subject the specimens to a prescribed number of exposures in accordance with the specification in 6.2. 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 No. 3 or 5 (see 6.1) 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.

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 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