INTERNATIONAL STANDARD

ISO 105-B01

Fourth edition
1989-12-15

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Textiles — Tests for colour fastness —

Part B01:
Colour fastness to light: Daylight

Textiles — Essais de solidité des teintures —

Partie B01: Solidité des teintures à la lumière: Lumière du jour

Reference number
ISO 105-B01 : 1989 (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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 105-B01 was prepared by Technical Committee ISO/TC 38, *Textiles.*

This fourth edition cancels and replaces the third edition (ISO 105-B01 : 1988), of which it constitutes a minor revision.

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

Annexes A and B of this part of ISO 105 are for information only.

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International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Printed in Switzerland

Textiles — Tests for colour fastness —

Part B01:
Colour fastness to light: Daylight

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1 Scope

1.1 This part of ISO 105 specifies a method intended for determining the resistance of the colour of textiles of all kinds and in all forms to the action of daylight.

1.2 If there is a possibility of the sample being photochromic, then the test for photochromism shall be applied additionally (see ISO 105-B05).

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

NOTE — General information on colour fastness to light is given in annex A.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 105. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 105 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 105-A01: 1989, *Textiles — Tests for colour fastness — Part A01: General principles of testing.*

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

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

3 Principle

A specimen of the textile is exposed to daylight under prescribed conditions, including protection from rain, along with eight dyed wool references. The colour fastness is assessed by comparing the change in colour of the specimen with that of the references.

4 Reference materials and apparatus

4.1 Reference materials

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

The correlation between the two sets of blue wool references, illustrated in figure 1, shall not be used to convert ratings obtained from exposure based on one set of references to the other.

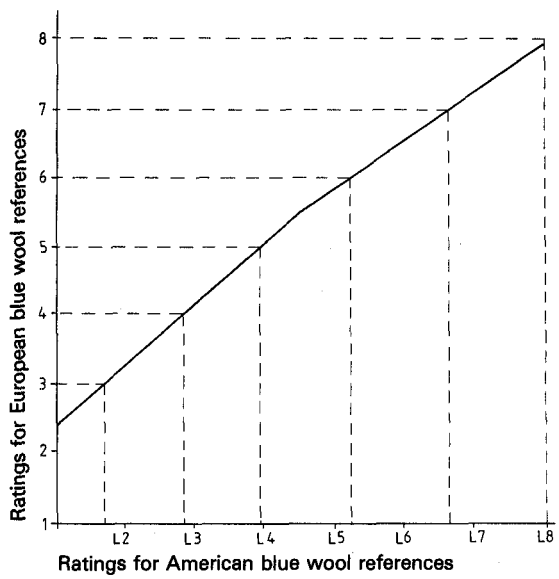

Figure 1 — Correlation of blue wool references for exposure to daylight

4.1.1 References 1 to 8

Blue wool references developed and produced in Europe are identified by the numerical designation 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) (see 9.1).

Table 1 — Dyes for blue wool references 1 to 8

Reference	Dye — Colour Index designation[1)]
1	CI Acid Blue 104
2	CI Acid Blue 109
3	CI Acid Blue 83
4	CI Acid Blue 121
5	CI Acid Blue 47
6	CI Acid Blue 23
7	CI Solubilized Vat Blue 5
8	CI Solubilized Vat Blue 8

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

4.1.2 References L2 to L9

Blue wool references developed and produced in America are identified by the letter L followed by the numerical designation 2 to 9. These eight references are specially prepared by blending varying proportions of wool dyed with CI Mordant Blue 1 (Colour Index, Third edition, 43830) and wool dyed with CI Solubilized Vat Blue 8 (Colour Index, Third edition, 73801), so that each higher-numbered reference is approximately twice as fast as the preceding reference (see 9.2).

Figures 2 and 3 illustrate mounting of the blue wool references, but do not show any numerical or performance relationship between the two sets of references.

4.2 Apparatus

4.2.1 Exposure rack, facing south in the Northern hemisphere, north in the Southern hemisphere and sloping at an angle from the horizontal approximately equal to the latitude of the place where the exposure is made. The rack shall be sited preferably in a non-residential, non-industrial area free from dust and automobile exhaust fumes.

The rack shall be placed so that shadows of surrounding objects, including any framing, will not fall on the exposed materials and constructed so that the latter are firmly held. There shall be adequate ventilation behind the mounted specimens and the rack shall be covered with window glass to protect the specimens from rain and other elements of the weather. The transparency of the glass used shall be at least 90 % between 380 nm and 750 nm, falling to 0 % between 310 nm and 320 nm.

The minimum permissible distance between the glass and the surface of the specimens is 5 cm. In order to minimize shadows due to the varying angle of the sun, the usable exposure area under the glass is limited to that of the glass cover reduced on each side by twice the distance from the glass cover to the specimen.

4.2.2 Opaque cardboard, or other thin opaque material, for example thin sheet aluminium, or cardboard covered with aluminium foil, or, in the case of pile fabrics, a cover that avoids surface compression.

4.2.3 Grey scale for assessing change in colour, in accordance with ISO 105-A02.

5 Test specimen

5.1 An area of the material not less than 1 cm × 6 cm is used for method 1 (see 6.1) or 1 cm × 10 cm for method 2 (see 6.2) so that each exposed portion is not less than 1 cm × 2 cm. The specimen may be a strip of cloth, yarns wound close together on a card or laid parallel and fastened on a card, or a mat of fibres combed and compressed to give a uniform surface and fastened on a card.

5.2 To facilitate handling, the specimen or specimens to be tested and the similar strips of the references may be mounted on a card in an arrangement as indicated in figure 2 or figure 3 (see 6.1 or 6.2).

5.3 The specimens to be tested and the blue strips of the references shall be of equal size and shape in order to avoid errors in assessment due to over-rating the visual contrast between exposed and unexposed parts on a larger pattern as against narrower references.

6 Procedure for mounting, exposure and preliminary assessment of colour fastness

Expose the specimen (or group of specimens) and the references simultaneously for 24 h per day under the conditions described in 4.2.1, in such a manner and for such times as are necessary to evaluate fully the colour fastness of each specimen relative to that of the references, by successively covering the specimens and exposed references throughout the duration of the test. Four suggested methods follow.

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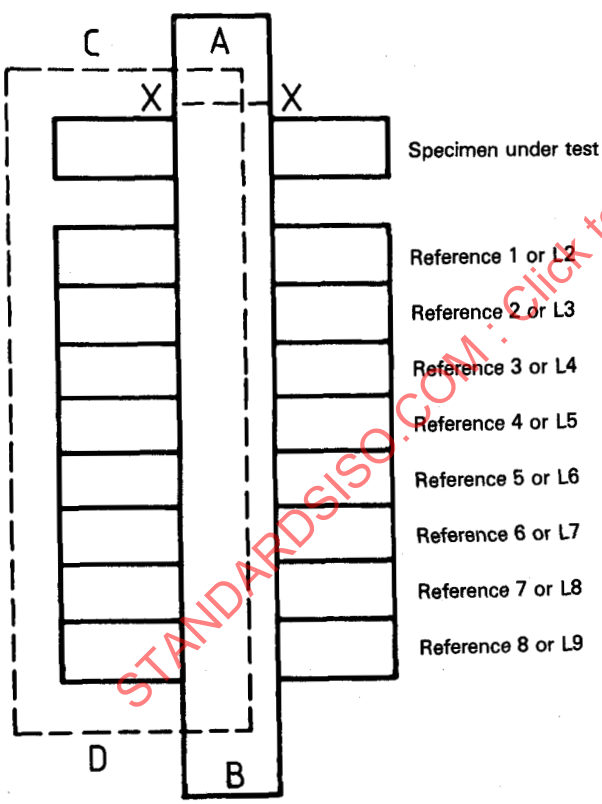
6.1 Method 1

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

6.1.2 Arrange the specimen to be tested and the references as shown in figure 2 with an opaque cover AB across the middle one-third of the specimen and references. Expose to daylight under the conditions described in 4.2.1. Follow the effect of light by removing the cover AB and inspecting the specimen frequently. When a change can be perceived equal to grey scale 4-5, note the number of the reference showing a similar change. (This is a preliminary assessment of colour fastness.) At this stage attention shall be given to the possibility of photochromism (see ISO 105-B05).

6.1.3 Continue to expose until the contrast between the exposed and the unexposed portions of the specimen is equal to grey scale grade 4. Cover a second one-third of the specimen and references with an additional opaque cover (CD in figure 2).



AB: Opaque cover.

May be hinged at X-X so that it can be lifted and returned to the same place over the specimen and references.

CD: Second cover.

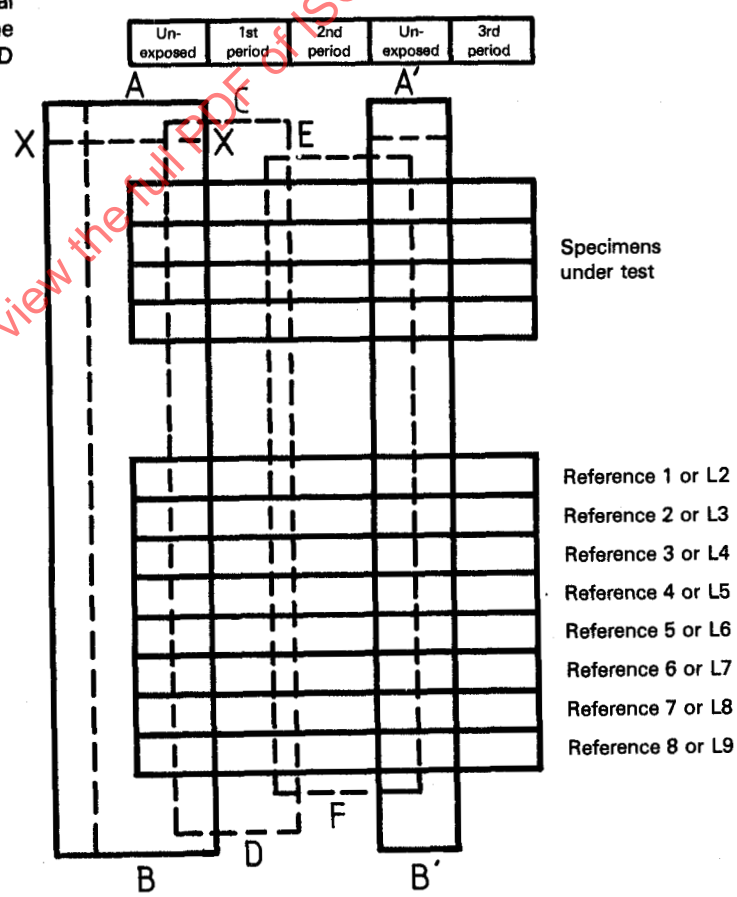
Figure 2 — Mounting for method 1

6.1.4 Continue to expose until the contrast between the fully exposed and unexposed portions is equal to grey scale grade 3.

6.1.5 If Reference 7 or L7 fades to a contrast equal to grey scale grade 4 before the specimen does, the exposure may be terminated at this stage. When a specimen has a colour fastness equal to or greater than 7 or L7, it would require unduly long exposure to produce a contrast equal to grey scale grade 3; moreover, this contrast would be impossible to obtain when the colour fastness is 8 or L9. Assessments in the region of 7 to 8 or L7 to L9 are made, therefore, when the contrast produced on Reference 7 or L7 is equal to grey scale grade 4, the time required to produce this contrast being long enough to eliminate any error which might result from inadequate exposure.

6.2 Method 2

6.2.1 This method is intended for use when a large number of specimens have to be tested simultaneously. The basic feature is the control of the exposure period by inspection of the



AB and A′B′: Opaque covers.

AB may be hinged at X-X so that it can be lifted and returned to the same place over the specimens and references.

CD: Third cover.

EF: Fourth cover.

Figure 3 — Mounting for method 2

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references, which allows a number of specimens differing in colour fastness to be tested against a single set of references, thus conserving supplies.

6.2.2 Arrange the specimens to be tested and the references as shown in figure 3, with covers A'B' and AB each covering one-fifth of the total length of each specimen and reference. Expose to daylight under the conditions described in 4.2.1. Follow the effect of light by lifting cover AB periodically and inspecting the references. When a change in Reference 3 or L2 can be perceived equal to grey scale grade 4-5, inspect the specimens and rate their colour fastness by comparing any change that has occurred with the changes that have occurred in References 1, 2 and 3 or L2. (This is a preliminary assessment of colour fastness.) At this stage attention shall be given to the possibility of photochromism (see ISO 105-B05).

6.2.3 Replace the lifted cover AB in exactly the same position and continue to expose until a change in Reference 4 or L3 can be perceived equal to grey scale grade 4-5; at this point fix an additional cover CD in the position shown in figure 3, overlapping the cover AB.

6.2.4 Continue to expose until a change in colour in Reference 6 or L5 can be perceived, equal to grey scale grade 4-5; then fix the final cover EF in the position shown in figure 3, the other three covers remaining in position.

6.2.5 Expose until either

a) a contrast is produced on Reference 7 or L7 equal to the contrast illustrated by grey scale grade 4; or

b) a contrast equal to grey scale grade 3 is produced on the most resistant specimen,

whichever occurs first.

6.3 Method 3

Where the test is to be used to check conformity with a performance specification, it is permissible to expose the specimens with two references only: that specified as minimum and the one below it. Continue exposure until grey scale grade 4 and grey scale grade 3 contrasts have been produced on separate areas of the minimum reference.

6.4 Method 4

Where the test is to be used to check conformity with an agreed reference sample, it is permissible to expose the specimens with the reference sample only. Continue exposure until grey scale grade 4 and/or grey scale grade 3 contrasts have been produced on the reference sample.

7 Assessment of fastness to light

7.1 The final assessment in numerical ratings is based on contrasts equal to grey scale grade 4 and/or grade 3 between exposed and unexposed portions of the specimen.

7.2 Remove all the covers, thus revealing on specimens and references two or three areas, depending on the method used, which have been exposed for different times, together with at least one area which has not been exposed to light. Compare, under suitable illumination (see ISO 105-A01 : 1989, clause 14), the changes of the specimen with the relevant changes of the references. The colour fastness of the specimen is the number of the reference which shows similar changes in colour (visual contrast between exposed and unexposed parts of the specimen). If the specimen shows changes in colour which are nearer to the imaginary reference midway between any two consecutive references than they are to either of the two consecutive references, the intermediate rating, for example 3-4 or L2-L3, shall be given.

If different assessments are obtained at the different degrees of contrast, the colour fastness of the specimen is the arithmetic mean of these expressed to the nearest whole or half grade. When three areas are being rated, take the mean of the contrasts closest to grades 4 and 3. Assessments, however, shall be confined to whole or midway ratings only. When the arithmetic mean gives a quarter or three-quarter rating, the assessment is defined as the next higher half or whole grade.

In order to avoid a misrating of the colour fastness of the specimen due to photochromism, the specimens shall be allowed to condition in the dark at room temperature for 24 h before the colour fastness is assessed (see ISO 105-B05).

7.3 If the colour of the specimen is more fugitive than that of Reference 1 or L2, a rating of 1 or L2 is given.

7.4 Comparison of the changes in the specimen with changes in the references 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 in turn with a similar mask of equal aperture.

7.5 If the colour fastness is equal to or higher than 4 or L3, any preliminary assessment based on the contrast equal to grey scale 4-5 (see 6.1.2 and 6.2.2) becomes significant; if this preliminary assessment is 3 or L2, it shall be included in the rating in brackets. For example, a rating of 6(3) indicates that the specimen changes very slightly in the test when Reference 3 just begins to fade, but that on continuing the exposure the resistance to light is equal to that of Reference 6.

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

7.7 The term "change in colour" includes changes in hue, depth, brightness, or any combination of these characteristics of colour (see ISO 105-A02 : 1987, sub-clause 2.6).

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8 Test report

8.1 For method 1 or 2

Report the numerical rating for colour fastness to light. The fastness rating shall be expressed either

a) by the figure alone (when using the references designated 1 to 8); or

b) together with the prefix L (when using the references designated L2 to L9).

If the rating is equal to or higher than 4 or L3 and the preliminary assessment is equal to or lower than 3 or L2, report the latter figure in brackets. If the specimen is photochromic, the colour fastness shall be followed by a P bracketed together with the grey scale rating.

8.2 For method 3 or 4

Report the classification "satisfactory" or "unsatisfactory" together with the performance reference or the reference sample used.

8.3 For all methods

Report the method used and the exposure conditions.

9 Notes

9.1 The colour fastness references 1 to 8 are specially dyed to match a master set of references in colour and in fading behaviour. It has been found that, when repeated dyeings of the blue dyed references are made, the amount of dye required to match the previous lot is often different from that originally used. The dyeing strengths would, therefore, be misleading and they are intentionally omitted from the listing in table 1.

9.2 In the colour fastness references L2 to L9, the two primaries are specially dyed and the blending proportions adjusted so that repeat productions of the references have the same fading characteristics. It has been found in repeat production of the references that the amount of each dye and the proportion of the fugitive and fast-dyed primaries needs to be adjusted to obtain the same fading behaviour in the various references. The dyeing strengths of the two primaries and the blending proportions are intentionally omitted.

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Annex A
(informative)

General information on colour fastness to light

When in use, textiles are usually exposed to light. Light tends to destroy colouring matters and the result is the well known defect of "fading", whereby coloured materials change colour — usually becoming paler and duller. Dyes used in the textile industry vary enormously in their resistance to light and it is obvious that there needs to be some method of measuring their fastness. The substrate also influences the light fastness of a dye.

This International Standard cannot satisfy completely all the interested parties (who range from dye manufacturers and the textile industry to wholesale and retail traders and the general public) without becoming technically involved and possibly difficult to understand by many who have a direct interest in its application.

The following non-technical description of the test has been prepared for the benefit of those who find the detailed technicalities of the standard difficult to understand. The method is to expose the pattern being tested and to expose also, at the same time and under the same conditions, a series of light fastness references which are pieces of wool cloth dyed with blue dyes of different degrees of fastness. When the pattern has faded sufficiently, it is compared with the references and if it has behaved, for instance, like Reference 4[1], then its light fastness is said to be 4.

The light fastness references should cover a wide range since some patterns fade noticeably after exposure for 2 or 3 h to bright summer sunshine, although others may withstand several years' exposure without change, the dyes in fact outliving the material to which they have been applied. Eight references have been chosen, Reference 1 being the most fugitive and Reference 8 the most resistant. If it takes a certain length of time for Reference 4 to fade under certain conditions, then the same amount of fading will occur on Reference 3 in approximately half that time, or on Reference 5 in approximately twice that time, provided that the conditions are the same.

It is necessary to ensure that different people testing the same material will fade it to the same extent before assessment against the simultaneously faded reference. The ultimate users of dyed material differ widely in what they consider to be "faded articles" and therefore patterns under test are faded to two different degrees which adequately cover most opinions and make assessment more reliable. These required degrees of fading are defined by reference to a collection of reference contrasts (grey scale 5 equals no contrast, grey scale 1 equals large contrast). Thus the use of the grey scale enables fading to be taken to defined extents, and the blue wool cloths enable the light fastness to be rated.

This general principle of assessing on the basis of moderate and severe fading is complicated, however, by the fact that some patterns on exposure undergo a slight change very rapidly indeed but do not change further for a long time. These slight changes are such that under normal conditions of use they would seldom be observed, but in certain cases they become important, as the following example shows.

> Some curtain material is exposed so as to produce a moderate degree of fading and it is found that Reference 7 has faded to the same extent; the general light fastness of the fabric is therefore 7. A retailer has a length of this fabric in his window and on it is a cardboard ticket indicating the price. After a few days the ticket is removed and careful examination reveals the place where it has been resting because the surrounding cloth has changed shade slightly on exposure to light.

The important factor about this slight change is that it can only be detected when there is a sharp boundary between the exposed and unexposed areas, and these conditions rarely occur during normal use. The magnitude of this slight change would be given as an additional assessment in brackets. Thus a rating for a test could be 7(2), indicating a slight initial change equivalent to the first perceptible fade of Reference 2, but otherwise a high light fastness of 7.

A further unusual colour change is also catered for, namely photochromism. This effect is shown when a dye changes colour rapidly on exposure to strong light but on removal to a dark place the original colour returns more or less completely. The extent of photochromism is determined by the special test described in this part of ISO 105 and is shown in the rating by a number following the letter P within brackets; for example 6(P2) means a photochromic effect equal to a grey scale 2 contrast but permanent fading equal to that of Reference 6.

Finally, there are many patterns which change hue on prolonged exposure to light; for example, a yellow may become brown, or a purple may become blue. In the past there have been many arguments as to whether such patterns could be said to have faded or not. The technique used in parts B01 to B05 of ISO 105 is unambiguous on this point; it is visual contrast on exposure which is being measured, whether it be loss of colour or change in hue; in the latter case, however, the kind of change is included in the assessments. For example, consider two green patterns which, on exposure, change in appearance at the same rate as Reference 5; one becomes paler and finally white, while the other becomes first a greenish blue and finally a pure blue. The former would be rated "5" and the latter "5 bluer". In this instance also, the technique used in parts B01 to B05 of ISO 105 tries to present as complete a picture of the behaviour of a pattern on exposure as is possible without becoming excessively complicated.

1) The designations of the light fastness references referred to here are those of the European set (see sub-clause 4.1.1). The principles explained are equally valid for the American set (see sub-clause 4.1.2).

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