

INTERNATIONAL
STANDARD

ISO
105-B01

Fifth edition
1994-11-15

Textiles — Tests for colour fastness —

Part B01:

Colour fastness to light: Daylight

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Textiles — Essais de solidité des teintures —

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

ISO 105-B01:1994

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INTERNATIONAL

ISO



Reference number
ISO 105-B01:1994(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 voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 105-B01 was prepared by Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC 1, *Tests for coloured textiles and colorants*.

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This fifth edition cancels and replaces the fourth edition (ISO 105-B01:1989), of which it constitutes a technical 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

1 Scope

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.

This method allows the use of two different sets of blue wool references. The results from the two different sets of references may not be identical.

NOTE 1 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-A01:1994, *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:—¹⁾, *Textiles — Tests for colour fastness — Part A05: Method for the instrumental assessment of the change in colour of a test specimen*.

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

3 Principle

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

4 Reference materials and apparatus

4.1 Reference materials

Either of two sets of blue wool references may be used. The results from 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.

1) To be published.

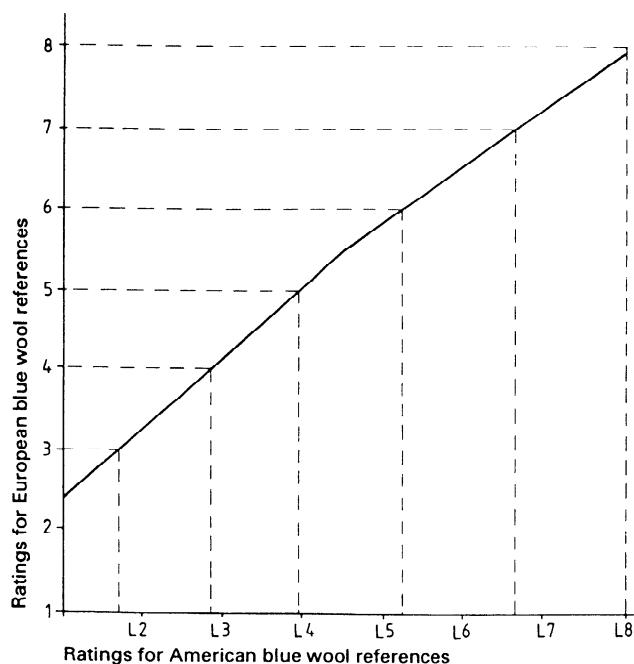


Figure 1 — Correlation of blue wool references for exposure to daylight

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) so that each higher-numbered reference is approximately twice as fast as the preceding one.

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.

4.1.2 References L2 to L9

Blue wool references developed and produced in the United States are identified by the letter L followed by the numerical designation 2 to 9. These eight references are specially prepared by blending varying proportions of wool dyed with CI Mordant Blue (Colour Index, third edition, 43830) and wool dyed with CI Solubilized Vat Blue 8 (Colour Index, third edition,

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., UK, and by the American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709, USA.

73801), so that each higher-numbered reference is approximately twice as fast as the preceding reference.

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 need 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.

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

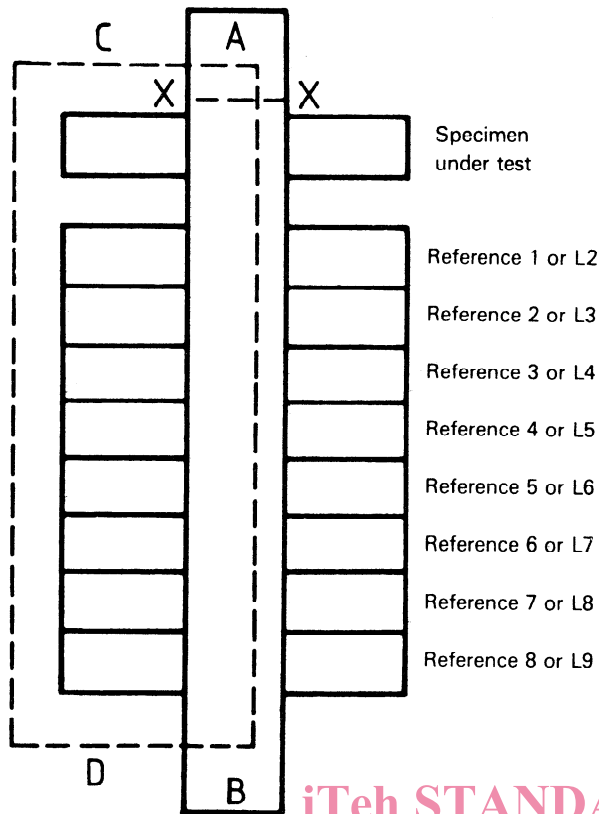


Figure 2 — Mounting of specimen and references for exposure method 1

specimens from rain and other elements of the weather. The glass cover shall be a clear flat drawn sheet, 5,0 mm to 10,0 mm thick. It shall be single-strength and free of bubbles or other imperfections. The transparency of the glass used shall be less than 1 % between wavelengths 300 nm and 320 nm, rising to at least 90 % between wavelengths 380 nm and 750 nm, measured from a light source simulating CIE, illuminant C.

The minimum permissible distance between the glass and the surface of the specimens is 50 mm. 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.

4.2.4 When requested, instruments for determining climatological data during the exposure, operated inside the cabinet and in the immediate area of the exposure cabinets.

Data obtained shall be reported as part of the results of the test. To characterize the conditions within the test frame, these instruments should be capable of recording black body temperature sensed under glass, total radiant energy and ultraviolet radiant energy (either broad or narrow bandpass), and relative humidity (daily minimum and maximum) at the same angle of exposure as the test specimens. To characterize the conditions outside the test frame, these instruments should be capable of recording ambient temperature (daily minimum and maximum), relative humidity (daily minimum and maximum), hours of precipitation (rain), and total hours of wetness (rain and dew).

5 Test specimen

5.1 An area of the material not less than 10 mm × 60 mm is used for method 1 (see 6.1) or 10 mm × 100 mm for method 2 (see 6.2) so that each exposed portion is not less than 10 mm × 20 mm. 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 Exposure methods

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. Five suggested methods follow.

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, only one set of blue wool references is required for each specimen under test.

6.1.2 Arrange the test specimen 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 in the test specimen can be perceived equal to grey scale 4-5 (4.2.3) note the number of the blue wool reference showing a similar change. (This is a preliminary assessment of colour fastness.)

At this stage, if there is a possibility of the sample being photochromic, then the test for photochromism shall be applied additionally (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 the left-hand one-third of the specimen and references with an additional opaque cover (CD in figure 2).

6.1.4 Continue to expose until the contrast between the fully exposed and unexposed portions of the test specimen 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 test 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 *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 test specimens 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, if there is a possibility of the sample being photochromic, then the test for photochromism shall be applied additionally (see ISO 105-B05).

6.2.3 Replace the lifted cover AB in exactly the same position and continue to expose the specimens 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 the specimens 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 blue wool 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 blue wool reference.

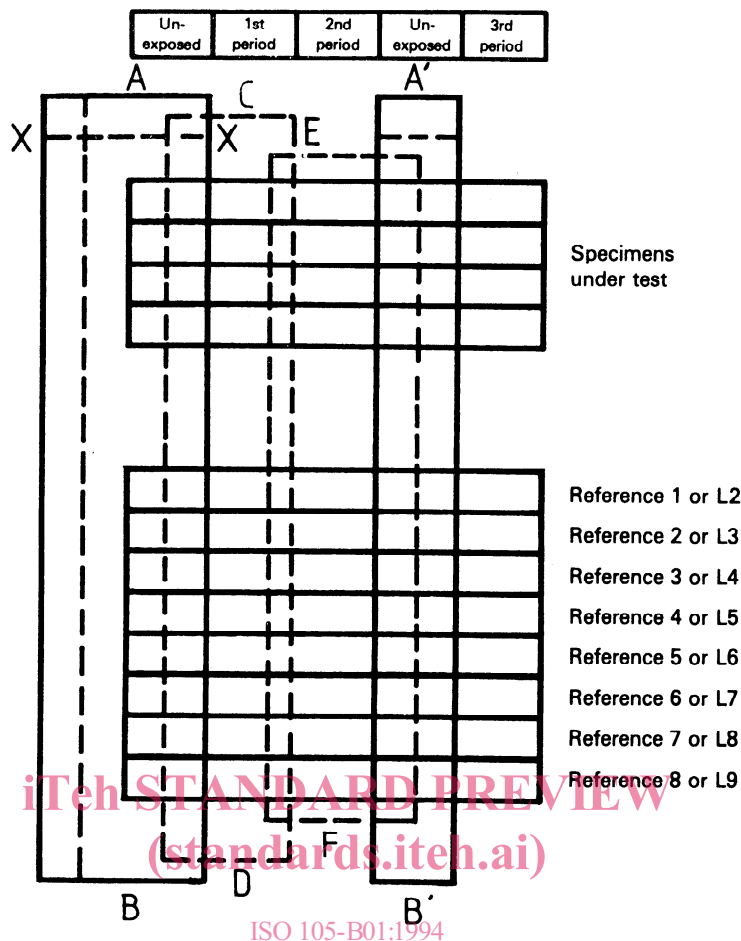


Figure 3 — Mounting of specimens and references for exposure method 2

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.

6.5 Method 5

Where the test is to be used to check conformity to agreed upon radiant energy levels, it is permissible to expose the specimens alone or with reference samples. The specimens should be exposed until the specified amount of radiant energy is reached, then removed, together with the reference samples and evaluated in accordance with 7.8.

7 Assessment of colour fastness to light

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

7.2 Remove all the covers, thus revealing on test 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-A01:1994, clause 14), the changes in the specimen with the relevant changes in 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, an 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 taken as 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-quarters 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 test 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, chroma, lightness, or any combination of these characteristics of colour (see ISO 105-A02:1993, clause 3).

7.8 The assessment of the colour fastness according to method 5 (see 6.5) is performed either by comparison with the grey scale for assessing change in colour in accordance with ISO 105-A02, or alternatively by comparison of the change in colour of the sample with that of the references.

8 Test report

The test report shall include the following information:

- a) the number and year of publication of this part of ISO 105, i.e. ISO105-B01:1994;
- b) all details necessary for identification of the sample tested;
- c) for method 1 or method 2:

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

- 1) by the number alone (when using the blue wool references designated 1 to 8); or
- 2) together with the prefix L (when using the blue wool 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 obtained from the test for photochromism, for example 6(P3-4);
- d) for method 3 or method 4:

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

- e) for method 5:

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

- 1) by the number alone (when using the references designated 1 to 8); or
- 2) together with the prefix L (when using the references L2 to L9); or
- 3) If no blue wool references are used, by the rating of the colour change assessed by comparison with the grey scale in accordance with ISO 105-A02 or by colour measurement in accordance with ISO 105-A05;

- f) the apparatus used, the method, the exposure conditions and the assessment conditions.

Annex A (informative)

General information on colour fastness to light

A.1 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 colour fastness of a dye to light.

This part of ISO 105 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.

A.2 The following non-technical description of a test for colour fastness to light has been prepared for the benefit of those who find the detailed technicalities of this part of ISO 105 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 colour 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 4²⁾, then its colour fastness is said to be 4.

A.3 The colour fastness references should cover a wide range, since some patterns fade noticeably after exposure for 2 h or 3 h to bright summer sunshine, although others may withstand long 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.

A.4 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 "grey scale" 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 colour 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.

A retailer has a length of curtain 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. Some of this 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 colour fastness of the fabric is therefore 7.

The important factor about this slight change in shade 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.

2) The designations of the colour fastness references referred to here are those of the European set (see 4.1.1). The principles explained are equally valid for the American set (see 4.1.2).