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Textiles — Tests for colour fastness —

Part B01: Colour fastness to light: Daylight

Textiles — Essais de solidité des coloris —

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

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Foreword

ISO (the International Organization for Standardization) is a worldwide ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 38; *Textiles*, Subcommittee SC 1, *Tests for coloured textiles and colorants*.

This sixth edition cancels and replaces the fifth edition (ISO 105-B01:1994), of which it constitutes a minor revision. It also incorporates Amendment ISO 105-B01:1994/Amd.1:1998.

ISO 105 consists of many parts designated by a part letter and a two-digit serial number (e.g. A01), under the general title *Textiles — Tests for colour fastness*. A complete list of these parts is given in ISO 105-A01.

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 General information on colour fastness to light is given in Annex A.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 105-A01:1994, *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, *Textiles — Tests for colour fastness — Part A05: Instrumental assessment of change in colour for determination of grey scale rating*

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

ISO 105-B08, *Textiles — Tests for colour fastness — Part B08: Quality control of blue wool reference materials 1 to 7*

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

4.1.1 General

Either of two sets of blue wool references may be used. The relationship between references 1 to 8 and L2 to L9 as shown with the method are approximate. Results from testing which uses reference standards from both sources should be compared only with the knowledge that fading characteristics may differ. 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.

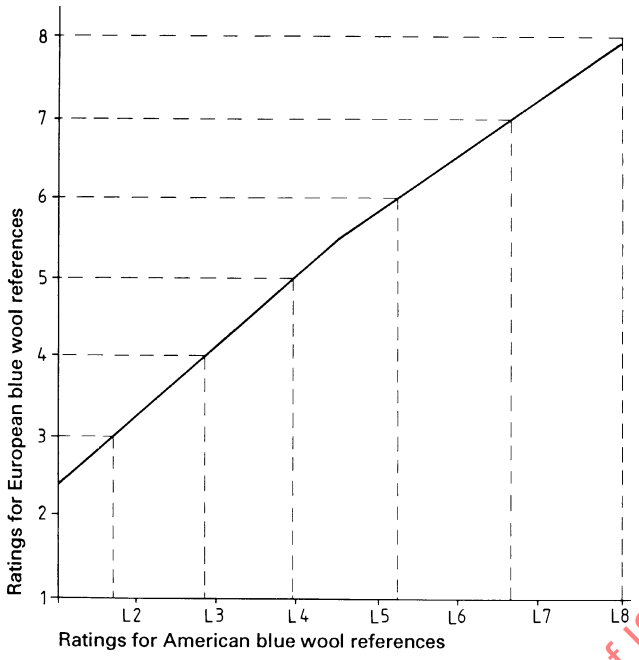

Figure 1 — Correlation of blue wool references for exposure to daylight

4.1.2 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.

The blue wool references 1 to 8 used in this test shall meet the quality requirements specified in ISO 105-B08.

4.1.3 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, 73801), so that each higher-numbered reference is approximately twice as fast as the preceding reference. Data in Annex B are presented to illustrate the relationship of each of the blue wool references on exposure to fixed amounts of radiant energy. A detailed summary of these test results is found in Reference [8].

Table 1 — Dyes for blue wool references 1 to 8

Reference	Dye — Colour Index designation[a]
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

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

In the colour fastness references L2 to L9, the two primaries are specially dyed and the blending pro portions 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.

Figure 2 and Figure 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 glass cover shall be a clear flat drawn sheet, (3,5 ± 1) 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.

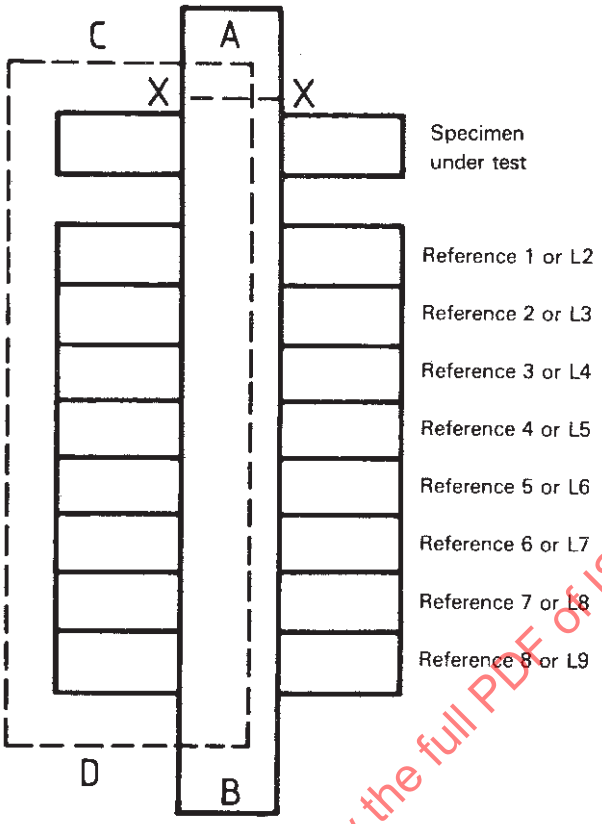

Figure 2 — Mounting of the specimen and references for exposure method 1

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 1 0 mm x 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 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 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). 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 fully exposed and unexposed portions of the test specimen is equal to grey scale grade 3.

6.1.4 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 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 2 can be perceived equal to grey scale grade 3 and in L2 to grade 4 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 cover AB in exactly the same position and continue to expose until a change in reference 3 or L3 can be perceived equal to grey scale grade 4; 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 4 or L4 can be perceived equal to grey scale grade 4; then fix the final cover EF in the position shown in Figure 3, the other 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 ex pose 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.

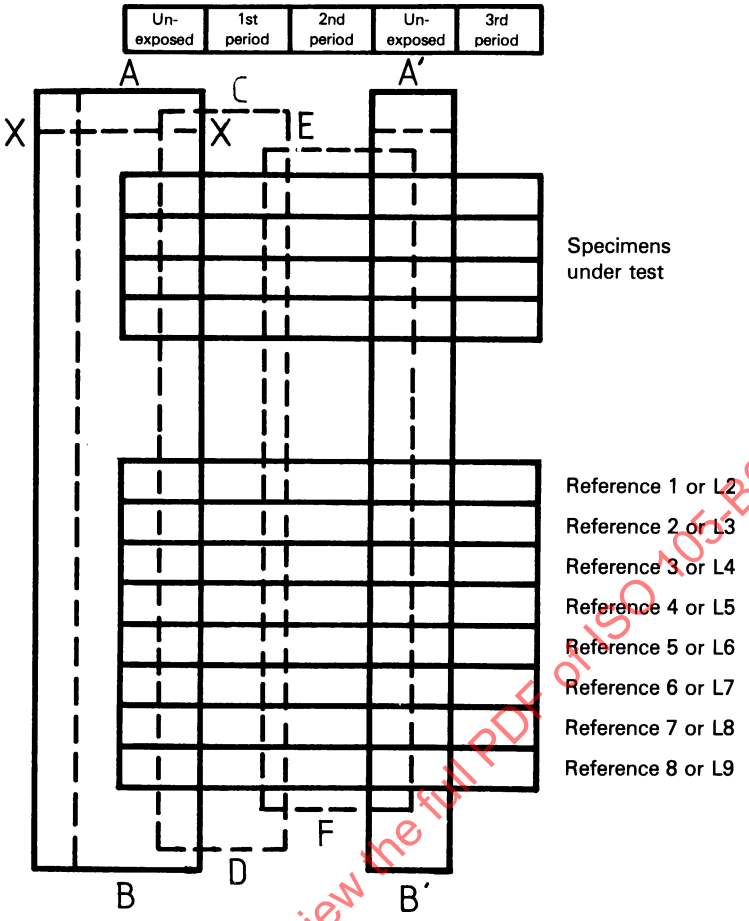

Figure 3 — Mounting of specimens and references for exposure method 2

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 tests 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, de pending on the method used, which have been ex posed 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 col our (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 ex pressed 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 migrating 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 (see 6.2.2) becomes significant. If this preliminary assessment is 3 or L2, it shall be included in the rating in parentheses. 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 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 f or 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 accord ing 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. ISO 105-B01:2014;

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 ex pressed 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 fast ness 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 col our 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 un der 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 4[1)], 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 ex tent 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.

1) The designations of the colour fastness references referred to here are those of the European set (see 4.1.2). The principles explained are equally valid for the American set (see 4.1.3).