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Textiles — Tests for colour fastness —

Part B03:

Colour fastness to weathering: Outdoor
exposure

Textiles — Essais de solidité des teintures —

Partie B03: Solidité des teintures aux intempéries: Exposition en plein air



Reference number
ISO 105-B03:1994(E)

Foreword

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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-B03 was prepared by Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC 1, *Tests for coloured textiles and colorants*.

This fourth edition cancels and replaces the third edition (included in ISO 105-B03:1988), of which it constitutes a technical revision.

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.

Annex A of this part of ISO 105 is for information only.

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Textiles — Tests for colour fastness —

Part B03:

Colour fastness to weathering: Outdoor exposure

1 Scope

This part of ISO 105 specifies a method intended for determining the resistance of the colour of textiles of all kinds except loose fibres to the action of weather as determined by outdoor exposure.

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-B01:1994, *Textiles — Tests for colour fastness — Part B01: Colour fastness to light: Daylight.*

ISO 105-C01:1989, *Textiles — Tests for colour fastness — Part C01: Colour fastness to washing: Test 1.*

3 Principle

3.1 Specimens of the textile are exposed under specified conditions in the open air without any protection from weathering. At the same time and in the same place, eight dyed blue wool references are exposed to daylight but are protected from rain, snow, etc., by a sheet of glass. The fastness is assessed by comparing the change in colour of the specimen with that of the blue wool references.

3.2 The wide variations in conditions under which outdoor exposures are usually carried out make it desirable to make replicate exposures starting at different times of the year. The most reliable indication of weathering fastness is obtained by taking the mean of the assessment of several exposures.

3.3 The term "change in colour" includes not only true "fading", i.e. destruction of dyes, but also changes in hue, chroma, lightness or any combination of these characteristics of colour. If the difference in colour is a change of hue or lightness, this can be indicated by adding abbreviations, as follows, to the numerical colour fastness rating:

Bl = bluer
Y = yellower
G = greener
R = redder
D = duller
Br = brighter

If the change in hue is accompanied by a change in chroma, this can also be indicated:

W = weaker

Str = stronger

4 Reference materials and apparatus

4.1 Reference materials

The references used in this test are those specified in ISO 105-A01 and ISO 105-A02, and in ISO 105-B01:1994, 4.1.1.

4.2 Apparatus

4.2.1 Exposure rack for specimens, facing due south in the Northern hemisphere, due 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 will not fall on the exposed textiles and constructed so that the specimens or the cloth on which the specimens are sewn (see 5.1) is firmly held. There shall be free circulation of air behind the mounted specimens.

4.2.2 Exposure rack for references, oriented as in 4.2.1 but designed to take mounted sets of colour fastness references, the racks being covered with glass having a transmission of at least 90 % between 380 nm and 750 nm, falling to 0 % between 310 nm and 320 nm.

4.2.3 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.

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

4.2.5 Instruments for determining climatological data during the exposure, operated in the immediate area of the exposure racks.

To characterize the conditions at 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), total hours of wetness (rain and

dew), 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.

When requested, data obtained shall be reported as part of the results of the test.

5 Test specimens

5.1 If the textile to be tested is fabric, use two specimens each measuring at least 40 mm x 100 mm. The specimens can be attached directly to the exposure rack (see 6.1) or sewn along each side onto a piece of scoured, undyed cloth made of hydrophobic fibre such as polyester or acrylic.

5.2 If the textile to be tested is yarn, knit or weave it into fabric and treat it as described in 5.1.

Loose fibres are not suitable for weathering tests.

5.3 Reference samples identical to those to be tested are required for comparison with the specimen during weathering.

5.4 Mount strips of colour fastness references on cardboard and cover the middle one-third as described in ISO 105-B01:1994, 6.1.

6 Procedure

6.1 Procedure common to methods 1, 2 and 3

Firmly attach to the exposure rack (4.2.1) the specimens or the cloth to which the specimens have been sewn. Place the mounted and partially covered blue wool references on the glass-covered rack (4.2.2). Expose the specimens and references simultaneously, 24 h per day, for such times as are necessary to evaluate the weathering fastness, using method 1, 2 or 3 (see 6.2 to 6.4).

6.2 Method 1

6.2.1 This method is considered most satisfactory and is mandatory 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. It is therefore impracticable when a large number of specimens have to be tested concurrently; in such cases, method 2 (see 6.3) shall be used.

6.2.2 Expose the specimens and the blue wool references under the conditions described in 6.1 until the contrast between the exposed specimens and a portion of the original fabric is equal to grey scale grade 3. Remove one of the specimens and cover the left-hand one-third of the references with an additional opaque cover.

6.2.3 Continue the exposure until the contrast between the remaining specimen and a portion of the original fabric is equal to grey scale grade 2. If reference 7 fades to a contrast equal to grey scale grade 4 before the contrast between the specimen and a portion of the original fabric is equal to grey scale grade 2, the exposure may be concluded at this stage and the remaining specimen and the references removed.

6.2.4 Wash both specimens, and a portion of the original fabric, and prepare them for assessment (see 6.5 and 6.6).

6.2.5 Assess the colour fastness to weathering in accordance with the method given in 7.1 to 7.4.

6.3 Method 2

6.3.1 This method should be used when the number of specimens to be tested simultaneously is so large that method 1 is impracticable. The basic feature of this method is the control of the exposure period by inspection of the *references*, which allows a number of specimens differing in weathering fastness to be tested against only one set of blue wool references, thus conserving supplies of the latter.

6.3.2 Expose the specimens and the blue wool references under the conditions described in 6.1 until the contrast between the exposed and unexposed portions of Reference 6 is equal to grey scale grade 4. At this stage remove one specimen from each pair and cover the left-hand one-third of the references with an additional opaque cover.

6.3.3 Continue the exposure until the contrast between the fully exposed and unexposed portions of Reference 7 is equal to grey scale grade 4. Remove the remaining specimens and the references.

6.3.4 Wash and dry the exposed specimens and a portion of the original fabric from each specimen and prepare them for assessment (see 6.4 and 6.5).

6.3.5 Assess the colour fastness to weathering of each specimen in accordance with the method given in 7.1 to 7.3.

6.4 Method 3

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 shall be exposed until the specified amount of radiant energy is reached, then removed together with the reference samples and evaluated as directed in 7.4.

6.5 Washing

Wash the exposed specimens and a portion of the original fabric measuring at least 40 mm × 100 mm (in the absence of adjacent fabrics) in accordance with ISO 105-C01.

6.6 Mounting

Trim and mount the washed specimens, one on each side of the washed original fabric which has been trimmed to the same size and shape as the specimens. The specimen exposed for the shorter length of time shall be mounted on the left.

7 Assessment of colour fastness to weathering

7.1 Assess the magnitude of the contrast between the specimen exposed for the *shorter* time and the original fabric in terms of the contrasts produced in the blue wool references exposed for the same period: the assessment is the number of the reference showing the contrast closest to that of the specimen. If the specimen shows changes in colour approximately half-way between two references, an appropriate half-rating, for example 3-4, shall be given.

7.2 Assess the magnitude of the contrast between the specimen exposed for the *longer* time and the original fabric in terms of the contrasts produced in the blue wool references exposed for the same period: the assessment is the number of the reference showing the contrast closest to that of the specimen. If the specimen shows changes approximately half-way between two references, an appropriate half-rating, for example 5.6, shall be given.

7.3 If specimens larger than the references are exposed, a mask of a neutral grey colour approximately midway between that illustrating grade 1 and that illustrating grade 2 of the grey scale for assessing change in colour (approximately Munsell N5) shall be used in assessment, the mask covering the surplus area of the specimens and leaving an area equal to

that of the references open for comparative evaluation.

7.4 The assessment of the colour fastness according to method 3 (see 6.4) is performed with the grey scale for assessing change in colour (4.2.4) in accordance with ISO 105-A02, or alternatively by comparison of the colour change of the sample with that of the blue wool 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-B03:1994;

- b) all details necessary for complete identification of the sample tested;
- c) for methods 1 and 2, the numerical blue wool rating for weathering fastness: outdoor exposure. If the two assessments (see 7.1 and 7.2) are different, report only the lower;
- d) for method 3, either the numerical rating for the change in colour of the sample, or the numerical rating for weathering fastness: outdoor exposure;
- e) the place of exposure and date/time of beginning and end of the exposure.

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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 need 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 4¹⁾, 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 out-living 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 light 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 ISO 105-B01:1994, 4.1.1). The principles explained are equally valid for the American set (see ISO 105-B01:1994, 4.1.2).

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. 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 colour fastness of 7.

A.5 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 ISO 105-B05, 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.

A.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 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.

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