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Textiles — Tests for colour fastness —

Part B04:
Colour fastness to weathering: Xenon arc

Textiles — Essais de solidité des teintures —

Partie B04: Solidité des teintures aux intempéries: Lampe à arc au xénon

Reference number
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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-B04 was prepared by Technical Committee ISO/TC 38, *Textiles.*

This third edition cancels and replaces the second edition (included in ISO 105-B : 1984), of which it constitutes a minor 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.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Textiles — Tests for colour fastness —

Part B04:
Colour fastness to weathering: Xenon arc

1 Scope and field of application

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 exposure in a cabinet equipped with a xenon arc lamp.

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

2 References

ISO 105, *Textiles — Tests for colour fastness —*

Part A01: General principles of testing.

Part A02: Grey scale for assessing change in colour.

Part B01: Colour fastness to light: Daylight.

Part B02: Colour fastness to artificial light: Xenon arc fading lamp test.

3 Principle

Specimens of the textile are exposed under specified conditions to light from a xenon arc lamp and to water spray. At the same time, eight dyed wool references are exposed to light but are protected from water spray by a sheet of window-glass. The 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

The references used in this test are those specified in ISO 105-A01 and ISO 105-A02, and sub-clause 4.1.1 of ISO 105-B01.

4.2 Apparatus

4.2.1 Light source, in a well ventilated exposure chamber.

The light source is a xenon arc lamp of correlated colour temperature 5 500 to 6 500 K.

4.2.2 Light filter.

A filter is placed between the light source and the specimens and references so that the ultra-violet spectrum is steadily reduced. The glass used shall have a transmission of at least 90 % between 380 and 750 nm, falling to 0 % between 310 and 320 nm.

4.2.3 Heat filters.

The spectrum of the xenon arc contains an appreciable amount of infra-red radiation which should be minimized by heat filters. The temperature conditions can then be satisfied. The filters shall be cleaned regularly to avoid undesirable reduction in light intensity by dirt.

4.2.4 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.

4.2.5 Grey scale for assessing change in colour (see clause 2).

4.3 Exposure conditions

The specimens and the references are exposed in the apparatus (4.2). The air temperature in the chamber shall be measured with a thermometer whose sensitive portion is shielded from the direct radiation of the arc (see 9.2).

The variation of the light intensity over the area covered by specimens and references shall not exceed ± 10 % of the mean.

4.3.1 Exposure of specimens

The specimens shall be subjected to the following accurately adjusted, reproducible weathering cycle:

- duration of spraying: 1 min;
- duration of drying: 29 min.

For spraying the specimens, only completely ion-free water shall be used. It should be especially noted that this water shall not contain any metal salts. Tubing, tanks and spray jets shall be of corrosion-resistant material.

The specimens shall be mounted on a suitable holder (see 9.4). The specimens shall completely enclose the holder and the side to be assessed shall not be in contact with metal plates, other specimens, or backing fabric.

4.3.2 Exposure of light fastness references

The Blue Wool References (4.1) shall be protected from the water spray by a shield of glass whilst being exposed to light from the same xenon arc lamp as the specimens. The transmission of the glass shall be at least 90 % between 380 and 750 nm, falling to 0 % between 310 and 320 nm. The glass case shall be well ventilated, i.e. there shall be an opening at the top and another at the bottom to allow a good circulation of air.

5 Test specimens

5.1 If the textile to be tested is fabric, prepare two specimens, each of a suitable size, mounted on holders or other equipment which will fit the weathering test equipment.

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 Mount strips of light fastness references on cardboard, cover one-third of each as described in sub-clause 6.2.1.2 of ISO 105-B02 and fix the mounted references according to 4.3.2.

6 Procedure

6.1 Procedure common to methods 1 and 2

6.1.1 Place the specimens mounted on the holders (see 4.3.1, 5.1 and 9.4) in the apparatus and expose them continuously to weathering following either method 1 or method 2 (see 6.2 and 6.3).

6.1.2 At the same time, expose the mounted and partially covered references (see 4.1 and 5.3) to light in the glass case of the same apparatus (see 4.3.2).

6.1.3 Only one side of the specimen shall be exposed to weathering and light.

6.1.4 Whilst the specimens are drying, the air in the test chamber shall not be moistened.

6.1.5 The conditions of the weathering test depend on the kind of test apparatus used.

6.1.6 Contrary to stipulations for the outdoor exposure test, the specimens shall not be washed after the weathering test.

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 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 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 a second 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 the 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 reference removed.

6.2.4 Prepare both specimens, and a portion of the original fabric for assessment (see 6.4 and 6.5).

6.2.5 Assess the weathering fastness in accordance with the method given in 7.1 to 7.3.

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 references, thus conserving supplies of the latter.

6.3.2 Expose the specimens and the 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 a second 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 Prepare the exposed specimens and a portion of the original fabric from each specimen for assessment (see 6.4 and 6.5).

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

6.4 Before mounting the tested specimens for assessment, dry them in air at a temperature not exceeding 60 °C.

6.5 Trim and mount the tested specimens so that they measure at least 1,5 cm × 3 cm, one on each side of a portion of the 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 weathering fastness

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 on the 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 5-6, 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 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.

7.3 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 the assessment, the mask covering the surplus area of the specimens and leaving an area equal to that of the references open for comparative evaluation.

8 Test report

Report the numerical rating for weathering fastness: xenon lamp. If the two assessments (see 7.1 and 7.2) are different, report only the lower. In addition, report the type of apparatus used for the test.

9 Notes

9.1 The term "change in colour" includes not only true "fading", i.e. destruction of dyes, but also changes in hue, depth, brightness or any combination of these characteristics of colour. If the difference in colour is a change of hue or brightness, 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 depth, this can also be indicated:

W = weaker
Str = stronger

9.2 The temperature in the test chamber (see 4.3) shall not exceed 40 °C during the drying period.

9.3 The temperature of the black panel which is measured in the centre and under the same illumination as the specimens shall not exceed that of the test chamber by more than 20 °C at the maximum drying period (black panel temperature, see subclause 9.2 of ISO 105-B02).

9.4 The holders described in *Textil-Rundschau*, **18**, (1963), 2, 76, photo 2, left, may be used. The manufacturer of these holders also supplies a case to protect the references.

Annex

General information on colour fastness to light

(This annex does not form an integral part of the standard.)

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 must 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.

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1) The designations of the light fastness references referred to here are those of the European set (see ISO 105-B01, sub-clause 4.1.1). The principles explained are equally valid for the American set (see ISO 105-B01, sub-clause 4.1.2).

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.

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