भारतीय मानक
Indian Standard

IS/ISO 105-B04 : 1994
*(Superseding IS 6152 : 1985)*

# वस्त्रादि — रंग के पक्केपन का परीक्षण

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# Textiles — Tests for Colour Fastness

Part B04 Colour Fastness to Artificial Weathering:
Xenon Arc Fading Lamp Test

ICS 59.080.01



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NATIONAL FOREWORD

This Indian Standard (Part B04) which is identical with ISO 105-B04 : 1994 'Textiles — Tests for colour fastness — Part B04: Colour fastness to artificial weathering: Xenon arc fading lamp test' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Chemical Methods of Test Sectional Committee and approval of the Textile Division Council.

This standard supersedes IS 6152 : 1985 'Methods for determination of colour fastness of textile materials to weathering by xenon arc lamp (*first revision*)'. After publication of this standard, it shall be treated as withdrawn.

Colour fastness of dyed/printed textile materials to various agencies during their further treatment or actual use is an important performance requirement from the viewpoint of the user or consumer. The various agencies to which textile materials may be subsequently subjected may include water, acids, alkalis, organic solvents, washing, laundering, dry-cleaning, perspiration, light, gaseous fumes, bleaching, rubbing, carbonizing, felting, etc, and the colour of textile materials should be fast to these agencies and should not change considerably. The colour should also not bleed and stain the adjacent fabric which is subjected to these agencies along with coloured fabric. The colour fastness property of coloured textiles is, therefore, measured in terms of colour fastness ratings with respect to change in colour and/or staining of adjacent fabric.

Since colour fastness is one of the most important requirements for export of textiles, it is considered essential that Indian Standards related to colour fastness are completely harmonized with International Standards. The various Indian Standards on colour fastness testing, are, therefore, being published/ revised to align them with the corresponding International Standards published in Parts A to Z.

This standard finds application in measurement of colour fastness of textile materials to the action of weather as determined by exposure to simulated weathering conditions in a cabinet equipped with a xenon arc lamp.

The text of ISO Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.
b) Comma(,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards, which are to be substituted in their places, are listed below along with their degree of equivalence for the editions indicated:

| *International Standard* | *Corresponding Indian Standard* | *Degree of Equivalence* |
|---|---|---|
| ISO 105-A01 : 1994 Textiles — Tests for colour fastness-Part A01: General principles of testing | IS/ISO 105-A01 : 1994 Textiles — Tests for colour fastness: Part A01 General principles of testing | Identical |
| ISO 105-A02 : 1993 Textiles — Tests for colour fastness-Part A02: Grey scale for assessing change in colour | IS/ISO 105-A02 : 1993 Textiles: Tests for colour fastness: Part A02 Grey scale for assessing change in colour | do |

(*Continued on third cover*)

*Indian Standard*

# TEXTILES — TESTS FOR COLOUR FASTNESS

## PART B04 COLOUR FASTNESS TO ARTIFICIAL WEATHERING: XENON ARC FADING LAMP TEST

## 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 exposure to simulated weathering conditions in a cabinet equipped with a xenon arc lamp.

This method can be used to determine if a textile is wet light-sensitive.

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-B02:1994, *Textiles — Tests for colour fastness — 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 blue 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.

If the method is used to determine if a textile is wet light-sensitive (see 4.3.1), the simultaneous exposure of references is unnecessary. In this case the assessment is performed by comparison with the grey scale in accordance with ISO 105-A02.

## 4 Reference materials and apparatus

### 4.1 Blue wool references

The reference materials used in this test are those blue wool references specified in ISO 105-A01 and ISO 105-A02, and subclause 4.1.1 of ISO B01:1994.

### 4.2 Apparatus

#### 4.2.1 Xenon arc lamp apparatus.

**4.2.1.1 Light source**, in a well-ventilated exposure chamber. The light source is a xenon arc lamp of correlated colour temperature 5 500 K to 6 500 K.

**4.2.1.2 Light filter**, placed between the light source and the specimens and references so that the ultraviolet spectrum is steadily reduced. The glass used shall have a transmission of 0 % between 290 nm and 300 nm, rising to at least 90 % between 380 nm and 750 nm.

**4.2.1.3 Heat filters**, placed between the light source and the specimens and references so that the amount of infrared radiation is steadily reduced.

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

**4.2.2 Radiometer** (when available/specified), for measuring irradiance and radiant exposure.

Since irradiance at the test specimen face can vary as a function of lamp intensity and lamp-to-specimen distance, a monitoring radiometer may be used to control uniformity of exposure. The radiometer permits exposure to an established level of irradiation (radiant energy flux per unit area) at a point in the plane of the specimen rack (see annex B).

**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.

## 4.3 Exposure conditions

The test specimens and the blue wool references are exposed simultaneously in the apparatus (4.2.1), the specimens to both light and water spray, and the references to light only. The air temperature in the chamber shall be measured with a thermometer whose sensitive portion is shielded from the direct radiation of the arc.

The temperature in the test chamber shall not exceed 40 °C during the drying period.

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 ISO 105-B02: 1994, subclause 4.2.3).

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

### 4.3.1 Exposure of test 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.

If the method is used to determine if a textile is wet light-sensitive, the weathering cycle shall be repeated for a total of 16 h testing.

The specimens shall be mounted on a suitable holder. 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.

NOTE 2 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.

### 4.3.2 Exposure of colour 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 0 % between 310 nm and 320 nm, rising to at least 90 % between 380 nm and 750 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 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 blue wool references on cardboard, (4.2.3), cover one-third of each as described in ISO 105-B02:1994, 7.2.1.2 and fix the mounted references under glass according to 4.3.2.

**5.4** Unexposed samples of original fabric identical to those being tested are required as references for comparison with the specimens during weathering.

## 6 Procedure

### 6.1 Procedure common to methods 1, 2 and 3

**6.1.1** Place the specimens mounted on the holders (see 4.3.1) in the apparatus and expose them continuously to weathering following method 1, 2 or 3 (see 6.2 to 6.4).

**6.1.2** At the same time, expose the mounted and partially covered blue wool 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 test 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.

NOTE 3 The actual conditions of the weathering test depend on the kind of test apparatus used.

**6.1.5** Contrary to stipulations for the outdoor exposure test, the speciments 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 blue wool references is required for each specimen under test. It is therefore impracticable when large numbers 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 (5.4) 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 unexposed original fabric is equal to grey scale grade 2. If blue wool 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** If textiles are to be examined for wet light-sensitivity, a 16 h testing period shall be used prior to assessment.

**6.2.6** Assess the colour fastness to weathering 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 blue wool *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 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 a second one-third of the blue wool 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 (5.4) from each specimen for assessment (see 6.5 and 6.6).

**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 of colour fastness to exposure to agreed-upon radiant energy levels, it is permissible to expose the specimens alone or with references. The specimens should undergo weathering for the time required for exposure to the specified level of radiant energy, then removed together with the blue wool references and evaluated in accordance with clause 7.

### 6.5 Drying

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

### 6.6 Mounting for assessment

Trim and mount the tested specimens so that they measure at least 15 mm × 30 mm, one on each side of a portion of the original fabric (5.4) 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 on the blue wool references exposed for the same period: the assessment is the number of the blue wool reference showing the contrast closest to that of the specimen. If the specimen shows changes in colour approximately half-way between two blue wool 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 blue wool references exposed for the same period: the assessment is the number of the blue wool reference showing the contrast closest to that of the specimen. If the specimen shows changes in colour approximately half-way between two blue wool references, an appropriate half-rating, for example 3-4, shall be given.

**7.3** If specimens larger than the blue wool 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 open an area equal to that of the blue wool references for comparative evaluation.

**7.4** To determine if the test specimen is wet light-sensitive, after 16 h weathering assess the magnitude of the contrast between the exposed specimen and the original fabric by comparison with the grey scale. If a colour change greater than 4-5 on the grey scale was obtained, the textile is judged to be wet light-sensitive; if a colour change of 4-5 or 5 on the grey scale was obtained, the textile is judged non-wet light-sensitive.

**7.5** The term "change in colour" includes not only true "fading", i.e. destruction of dyes, but also changes in hue, depth, 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 depth, this can also be indicated:

W = weaker
Str = stronger

## 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-B04:1994;

b) all details necessary for the identification of the sample tested;

c) for methods 1 and 2, the numerical rating for colour fastness to weathering: xenon lamp. 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 colour fastness to weathering: xenon lamp;

e) the type of apparatus used for the test;

f) optionally, if the textile was wet light-sensitive (see clause 7).

# 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 must 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 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 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.

**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.

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1) The designations of the colour fastness references referred to here are those of the European set (see ISO 105-B01:1994, subclause 4.1.1). The principles explained are equally valid for the American set (see ISO 105-B01:1994, subclause 4.1.2).

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 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.

# Annex B
(informative)

## Additional information concerning radiometers

Apparatus for use in this method may be equipped with a monitoring/controlling radiometer for controlling the lengths of exposure time. A radiometer employing a broad bandpass filter restricting measurement to the UV spectral region between 300 nm and 400 nm has been used satisfactorily.

Filter radiometers capable of integrating irradiance with respect to time are satisfactory.

The calibration of the radiometer shall be certified by the manufacturer for a specified time interval when used in the manner described herein.

(*Continued from second cover*)

| *International Standard* | *Corresponding Indian Standard* | *Degree of Equivalence* |
|---|---|---|
| ISO 105-B01 : 1994 Textiles — Tests for colour fastness- Part B01: Colour fastness to light: Day light | IS 686 : 1985 Method for determination of colour fastness of textile materials to daylight (*first revision*) | Technically |
| ISO 105-B02 : 1994 Textiles — Tests for colour fastness- Part B02: Colour fastness to artificial light: Xenon arc fading lamp test | IS 2454 : 1985 Methods for determination of colour fastness of textile materials to artificial light (Xenon lamp) (*first revision*) | do |

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounding off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in the standard.

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Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

This Indian Standard has been developed from Doc No.: TXD 05 (0798).

**Amendments Issued Since Publication**

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