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Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार"
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड़ नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS/ISO 105-C08 (2009): Textiles - Tests for Colour Fastness
: Part C08 Colour Fastness to Domestic and Commercial Laundering Using a Non-Phosphate Reference Detergent
Incorporating a Low Temperature Bleach Activator [TXD 5: Chemical Methods of Test]
Indian Standard

TEXTILES -- TESTS FOR COLOUR FASTNESS

PART C08   COLOUR FASTNESS TO DOMESTIC AND COMMERCIAL LAUNDERING USING A NON-PHOSPHATE REFERENCE DETERGENT INCORPORATING A LOW TEMPERATURE BLEACH ACTIVATOR

ICS 59.080.01
NATIONAL FOREWORD

This Indian Standard (Part C08) which is identical with ISO 105-C08 : 2001 Textiles — Tests for colour fastness — Part C08: Colour fastness to domestic and commercial laundering using a non-phosphate reference detergent incorporating a low temperature bleach activator 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.

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, drycleaning, 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 fabrics which are subjected to these agencies along with coloured fabrics. 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 fabrics.

Since colour fastness is one of the most important requirement 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 revised to align them with the corresponding international Standards. The Indian Standards are being published in Part A to Part Z.

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 in the International Standards, 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 respective places, are listed below along with their degree of equivalence for the editions indicated:

<table>
<thead>
<tr>
<th>International Standard</th>
<th>Corresponding Indian Standard</th>
<th>Degree of Equivalence</th>
</tr>
</thead>
</table>
This Indian Standard makes reference to following International Standards for which there are no Indian Standards. Extracts from these international standards are given in National Annex A*

<table>
<thead>
<tr>
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<th>Corresponding Indian Standard</th>
<th>Degree of Equivalence</th>
</tr>
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<tbody>
<tr>
<td>ISO 3801 : 1977 Textiles — Woven fabrics — Determination of mass per unit length and mass per unit area</td>
<td>IS 1964 : 2001 Methods for determination of mass per unit length and mass per unit area of fabrics (second revision)</td>
<td>do</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>International Standard</th>
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<tr>
<td>International Standard</td>
<td>Title</td>
</tr>
<tr>
<td>------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>ISO 105-J01 :1997</td>
<td>Textiles — Tests for colour fastness — Part J01: General principles for measurement of surface colour</td>
</tr>
</tbody>
</table>

The composition of the Committee responsible for the formulation of this standard is given in National Annex B.

Technical Corrigendum 1 to the above International Standard has been given after National Annex B.

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 :1960 'Rules for rounding off numerical values (revised)'.

iii
The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 105. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 105 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid international Standards.


1) European Colourfastness Establishment (ECE), BAM, Unter den Eichen 87, D-12203, Berlin, Germany.
3 Principle

A specimen of the textile in contact with specified adjacent fabric or fabrics is laundered, rinsed and dried. Specimens are laundered under appropriate conditions of temperature, alkalinity, bleaching and abrasive action such that the result is obtained in a conveniently short time. The abrasive action is accomplished by the use of an appropriate number of steel balls. The change in colour of the specimen and the staining of the adjacent fabric or fabrics are assessed with reference to the original fabric, either with the grey scales or instrumental.

4 Reagents and materials

4.1 Reference detergent.


4.1.2 Bleach activator, tetra-acetylene diamine, TAED.

4.1.3 Sodium perborate tetrahydrate.

4.2 Non-corrodible (stainless) steel balls, approximately 6 mm in diameter.

4.3 Adjacent fabrics (see 8.2 of ISO 105-A01:1994).

Either

4.3.1 A multifibre adjacent fabric, complying with ISO 105-F10, according to the temperature used:

— a multifibre adjacent fabric (DW) containing wool and acetate (for tests at 40 °C and 50 °C and in certain cases, to be indicated in the test report, at 60 °C);

— a multifibre adjacent fabric (TV) riot containing wool and acetate (in certain tests at 60 °C, and in all tests at 95 °C).

Or

4.3.2 Two single-fibre adjacent fabrics, complying with the relevant section F01 to F08 of ISO 105-F:1985. One of the adjacent fabrics shall be made of the same kind of the fibre as that of the textile to be tested or that predominating in the case of blends, and the second piece made of the fibre as indicated in Table 1 or, in the case of blends, of the kind of fibre second in order of predominance, or as otherwise specified.
Table 1 — Pairs of adjacent fabrics

<table>
<thead>
<tr>
<th>First piece</th>
<th>Second piece</th>
<th>For tests at 40 °C and 50 °C</th>
<th>For tests at 60 °C and 95 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>cotton</td>
<td>wool</td>
<td>—</td>
<td>viscose</td>
</tr>
<tr>
<td>wool</td>
<td>cotton</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>silk</td>
<td>cotton</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>viscose</td>
<td>wool</td>
<td>cotton</td>
<td>—</td>
</tr>
<tr>
<td>acetate</td>
<td>viscose</td>
<td>viscose</td>
<td>—</td>
</tr>
<tr>
<td>polyamide</td>
<td>wool or cotton</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>polyester</td>
<td>wool or cotton</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>acrylic</td>
<td>wool or cotton</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

4.3.3 Non-dyeable fabric, e.g. polypropylene, if required.

4.4 Grade 3 water, complying with ISO 3696.

4.5 Grey scale, for assessing change in colour and staining (ISO 105-A02; ISO 105-A03), or a spectrophotometer for assessing change in colour and staining complying with ISO 105-J01.

4.6 Acetic acid solution, containing 0,2 g of glacial acetic acid per litre if required for souring treatment.

5 Apparatus

5.1 Suitable mechanical laundering device, consisting of a water bath containing a rotatable shaft which supports, radially, stainless steel containers (75 mm ±5 mm diameter x125mm±10mm high) of capacity (550 ± 50) ml, the bottom of the containers being (45 mm ± 10 mm) from the centre of the shaft.

The shaft/container assembly is rotated at a frequency of (40 ± 2) min⁻¹. The temperature of the water bath is thermostatically controlled to maintain the test solution at the prescribed temperature ± 2 °C.

NOTE Other mechanical devices may be used for this test, provided that the results are identical with those obtained by the apparatus described in 5.1.

5.2 Balance, accurate to 0,01 g (see ISO 105-A01).

5.3 Mechanical Stirrer, minimum speed 16,667 s⁻¹ (1000r/min) to ensure thorough dispersion and prevent settling.

5.4 Flat-iron, (if required for pressing treatment), of mass not exceeding 2,5 kg and capable of giving the temperature indicated in {see A.9 b})].

6 Test specimen

6.1 If the textile to be tested is fabric, either

a) attach a specimen 100 mm x 40 mm to a piece of the multifibre adjacent fabric (4.3.1), also 100 mm x 40 mm, by sewing along one of the shorter edges, with the multifibre adjacent fabric next to the face side of the specimen

or

b) attach a specimen 100 mm x 40 mm between the two single-fibre adjacent fabrics (4.3.2), also 100 mm x 40 mm, by sewing along one of the shorter edges.
6.2 Yarn may be knitted into fabric and tested in this form. Where yarns or loose fibres are to be tested, take a mass of the yarn or loose fibre approximately equal to one-half of the combined mass of the adjacent fabrics and either:

a) place it between a 100 mm x 40 mm piece of the multifibre fabric (4.3.1) and a piece of the non-dyeable fabric (4.3.3), and sew them along four sides (see 9.3.3.4 of ISO 105-A01:1994)

or

b) place it between 100 mm x 40 mm pieces of the two specified single-fibre fabrics (4.3.2) and sew them along all four sides.

6.3 Determine the mass, in grams, of the composite specimen using the balance (5.2) to aid accurate liquor ratio volumes.

7 Test procedure

Provision is made in annex A for a washing procedure using a bleach activator and reference detergent.

8 Test report

The test report shall include the following information:

a) reference to this part of ISO105, i.e. ISO 105-C08;

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

c) the temperature of the method of test used (as listed in Table A.2);

d) the numerical grey scale rating or instrumental assessment for change in colour of the specimen,

e) if single-fibre adjacent fabrics were used, the numerical grey scale rating or instrumental assessment for staining of each kind of adjacent fabric used;

f) if a multifibre adjacent fabric was used, the type of multifibre adjacent fabric used and the numerical grey scale rating or instrumental assessment for staining of each fibre in the multifibre adjacent fabric;

g) whether steel balls have been used in the 40 °C or 50 °C tests;

h) whether the treatment in the acetic acid reagent described in A.7 was conducted;

i) whether the specimen was air dried or dried by pressing as described in A.9. If the latter, the temperature of the pressing treatment shall be reported;

j) the reference detergent and bleach activator.
Annex A  
(normative)

ECE non-phosphate reference detergent/TAED procedure

A.1 The reference detergent is supplied in three separate parts and the composition as given in Table A.1:

a) ECE non-phosphate reference detergent base powder (1998 formulation);
b) Bleach activator, tetra-acetylene diamine (TAED);
c) Sodium perborate tetrahydrate (Isla B0-4H2O).

For details of supply apply to: The Society of Dyers & Colourists, PO Box 244, 82 Grattan Road, Bradford BD1 2JB, England or Deutsche Echtheitskommission, Institutsweg 1, 85435 Erding, Germany.

Table A.1 — ECE 1998 non-phosphate reference detergent (without optical brightener)

<table>
<thead>
<tr>
<th>Base detergent</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear sodium alky benzene sulphonate (mean length of alkane chain C115)</td>
<td>9.7</td>
</tr>
<tr>
<td>Ethoxylated fatty alcohol C12-18 &lt;7EO)</td>
<td>5.2</td>
</tr>
<tr>
<td>Sodium soap, chain length C12-17 46 %: C 15-20 54 %</td>
<td>3.6</td>
</tr>
<tr>
<td>Foam inhibitor (DC-42485)</td>
<td>4.5</td>
</tr>
<tr>
<td>Sodium aluminium silicate (zeolite 4A)</td>
<td>32.5</td>
</tr>
<tr>
<td>Sodium carbonate</td>
<td>11.8</td>
</tr>
<tr>
<td>Sodium salt of a copolymer from acrylic and maleic acid</td>
<td>5.2</td>
</tr>
<tr>
<td>Sodium silicate (SiO2:Na2O = 3,3:1)</td>
<td>3.4</td>
</tr>
<tr>
<td>Carboxymethylcellulose (CMC)</td>
<td>1.3</td>
</tr>
<tr>
<td>Diethylene triamine penta (methylen phosphonic acid)</td>
<td>0.8</td>
</tr>
<tr>
<td>Sodium sulfate</td>
<td>9.8</td>
</tr>
<tr>
<td>Water</td>
<td>12.2</td>
</tr>
</tbody>
</table>

Tetra-acetylene diamine (TAED) (100 % active)* As separate addition

Sodium perborate tetrahydrate As separate addition

* The activity of the supplied TAED will be specified and is likely to be less than 100 %.

The required amount, in grams, of TAED per litre of wash liquor is calculated:

\[
0.15 \times 100 \\
\%
\text{activity}
\]

If it is desired to evaluate the effect of enzymes the optional addition of the following enzymes can be made with a corresponding reduction in the base detergent powder.

— Protease: Savinase 12T, reduction of 0.5 %
— Lipase: Lipolase 100T, reduction of 0.1 %
— Amylase: Thermamyl 60T, reduction of 0.3 %
— Cellulase: Celluzyme 0.7T, reduction of 0.3 %

5
All these enzymes are available from Novo Nordisk Bio-industrials. 1)

A.2 Prepare the wash liquor by dissolving 4 g of the ECE Non-Phosphate Reference Detergent Base powder [A.1 a)] plus 0.15 g TAED [A.1 b)3 (at 100 % activity) (see Table A.1 for details of calculation where the activity of the TAED is less than 100 %) and 1 g sodium perborate tetrahydrate [A.1 c)3 per litre of grade 3 water (4.4).

NOTE A minimum of 11 detergent solution should be prepared immediately prior to each laundering run.

A.3 Vigorously disperse the ECE Base detergent powder, sodium perborate tetrahydrate and TAED in the amounts specified in A.2 using a mixer with a minimum speed of 16,667 s~1 (1 000 r/min) in grade 3 water (4.4) at (25 ± 5) °C and stir for (10 ± 1) min.

A.4 Add to each container the volume of wash liquor required to give a liquor:fabric composite volume of 50:1 ratio. See Table A.2.

Place in the container the composite specimen together with the specified number of steel balls (4.2). Note the initial temperature (25 ± 5) °C, close the container and place in the laundering device and commence rotation.

<table>
<thead>
<tr>
<th>Temperature (± 2 °C) °C</th>
<th>Liquor: Fabric ml/g</th>
<th>Time at temperature min</th>
<th>Steel balls</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>50</td>
<td>30</td>
<td>25¹</td>
</tr>
<tr>
<td>50</td>
<td>50</td>
<td>30</td>
<td>25¹</td>
</tr>
<tr>
<td>60</td>
<td>50</td>
<td>30</td>
<td>25</td>
</tr>
<tr>
<td>95</td>
<td>50</td>
<td>30</td>
<td>25</td>
</tr>
</tbody>
</table>

¹ For delicate fabrics and articles of wool, silk or blends containing these fibres, steel balls are not used in the test. Record the use of steel balls in the test report [see 8 g].

A.5 Raise the temperature at the rate of (1.5 ± 0.5) °C per min to the temperature specified in Table A.2 and continue to run the test for a further (30 ±1) min at temperature.

A.6 For all tests, remove the composite specimen at the end of the wash and place in a 4 j beaker half filled with grade 3 water (4.4) at ambient temperature. Gently agitation, rinse for 1 min and then place the beaker under a cold running tap for 10 min.

A.7 In countries where the practice is to sour at the end of the washing operation, the following optional operation may be conducted.

Treat each composite specimen in a 100 ml portion of the acetic acid solution (4.6) for 1 min at 30 °C. Then rinse each composite specimen in a 100 ml portion of grade 3 water (4.4) for 1 min at 30 °C.

A.8 For all-methods, extract the excess water from the composite specimen.

1) This information is given for the convenience of users of this part of ISO105 and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.
A.9 For all methods, dry the specimen using one of the following procedures:

a) by hanging it in air at a temperature not exceeding 60 °C, with the parts in contact only at the line of stitching;

b) in countries where the practice is to dry fabrics by pressing, each specimen may be dried by pressing it with the flat-iron (5.4) at the temperature appropriate to the fabric under test, but in no case at a temperature above 150 °C, with the adjacent fabric uppermost and in contact with the specimen.

A.10 Assess the change in colour of the specimen and the staining of the adjacent fabric with reference to the original specimen using either the grey scales or instrumentally. See ISO 105-A02; ISO 105-A03; ISO 105-A04; ISO 105-A05; ISO 105-J03.

The fabric shall have the following properties.

Mass per unit area: $125 \pm 5 \text{ g/m}^2$.

Colour specification: The CIE chromaticity coordinates for CIE standard illuminant $D_{65}$ and CIE 1964 supplementary standard colorimetric observer ($10^\circ$ observer).

$$x_{10} = 0.337 \pm 0.002$$

$$y_{10} = 0.356 \pm 0.002$$ with the luminance factor

The yellowness $(G)$ of the fabric shall be $G = 25 \pm 2$ when determined by the formula:

$$G = \frac{1.301 X_{10} - 1.149 Z_{10}}{Y_{10}} \times 100$$

NOTE: Formula described in DIN 6167.

The pH of the aqueous extract shall be $7 \pm 0.5$ when determined by the method described in ISO 3071.

The mass fraction of residual dichloromethane - soluble matter shall be $(0.5 \pm 0.1)$ percent.

The alkali solubility shall not exceed 18 percent when determined by the method in ISO 3072.

A-2 Extracts from Textiles — Tests for colour fastness — Part F02: Specification for cotton and viscose adjacent fabric

A-2.1 Specification for Cotton and Viscose Adjacent Fabric Cotton

The fabric shall have the following properties:

Mass per unit area: $(1.15 \pm 5) \text{ g/m}^2$ when determined in accordance with ISO 3801.

Whiteness value: $Y_{10} = 80 \pm 2$

$W_{10} = 73 \pm 2$

$T_{10} = -1 \pm 1$ (that is -2 to 0)

Measurements shall be made with specular included in accordance with ISO 105-J03, excluding 0/45 (45/0). Luminance $(Y_{10})$, Whiteness $(W_{10})$ and Tint $(T_{10})$ values shall be calculated using CIE standard illuminant $D_{65}$ and CIE 1964 supplementary standard colorimetric observer ($100^\circ$ observer). pH of the aqueous extract shall be $7.0 \pm 0.5$ when determined by the method described in ISO 3071.

A-2.2 Viscose

The fabric shall have the following properties:

Mass per unit area: $(140 \pm 5) \text{ g/m}^2$ when determined in accordance with ISO 3801.

Whiteness value: $Y_{10} = 85 \pm 3$

$W_{10} = 58 \pm 4$

$T_{10} = -1 \pm 1$ (that is -2 to 0)
Measurements shall be made with specular included in accordance with ISO 105-J03, excluding 0/45 (45/0). Luminance ($Y_{10}$), Whiteness ($W_{10}$) and Tint ($T_{10}$) values shall be calculated using CIE standard illuminant $D_m$ and CIE 1964 supplementary standard colorimetric observer (100 observer).

A-3 Extracts from Textiles — Tests for colour fastness — Part F03: Specification for polyamide adjacent fabric

The fabric shall have the following properties.

Mass per unit area: 130 ± 5 g/m$^2$.

Whiteness value: $Y_{10} = 86 ± 2$ $W_{10} = 65 ± 2$ $T_{10} = -1 ± 1$ (i.e. -2 to 0)

Measurements shall be made with specular included in accordance with ISO 105-J01, excluding 0/45 (45/0). Luminance ($Y_{10}$), Whiteness ($W_{10}$) and Tint ($T_{10}$) values shall be calculated using CIE standard illuminant $D_65$ and CIE 1964 supplementary standard colorimetric observer (10° observer).

The pH of the aqueous extract shall be 7 ± 0.5 when determined by the method described in ISO 3071.


The fabric shall have the following properties.

Mass per unit area: 130 ± 5 g/m$^2$.

Whiteness value: $Y_{10} = 86 ± 2$ $W_{10} = 70 ± 2$ $T_{10} = 0 ± 1$ (i.e. -1 to 1)

Measurements shall be made with specular included in accordance with ISO 105-J01, excluding 0/45 (45/0). Luminance ($Y_{10}$), Whiteness ($W_{10}$) and Tint ($T_{10}$) values shall be calculated using CIE standard illuminant $D_65$ and CIE 1964 supplementary standard colorimetric observer (10° observer).

The pH of the aqueous extract shall be 7 ± 0.5 when determined by the method described in ISO 3071.


The fabric shall have the following properties.

Mass per unit area: 135 ± 5 g/m$^2$.

Whiteness value: $Y_{10} = 86 ± 2$ $W_{10} = 67 ± 2$ $T_{10} = 1 ± 1$ (i.e. 0 to 2)

Measurements shall be made with specular included in accordance with ISO 105-J01, excluding 0/45 (45/0). Luminance ($Y_{10}$), Whiteness ($W_{10}$) and Tint ($T_{10}$) values shall be calculated using CIE standard illuminant $D_{65}$ and CIE 1964 supplementary standard colorimetric observer (10° observer).

The pH of the aqueous extract shall be 7 ± 0.5 when determined by the method described in ISO 3071.
A-6 Extracts from Textiles — Tests for colour fastness — Part F06: Specification for silk adjacent fabric

The fabric shall have the following properties.

Mass per unit area: 60 ± 3 g/m².
Whiteness value: \( Y_{10} = 91 \pm 2 \)
\( W_{12} = 79 \pm 3 \)
\( T_{10} = -1 \pm 1 \) (i.e. -2 to 0)

Measurements shall be made using the instrument geometry d/0, specular included in accordance with ISO 105-J01. Luminance \((Y_{10})\), Whiteness \((W_{10})\) and Tint \((T'_{10})\) values shall be calculated using CIE standard illuminant D\(^6\) and CIE 1964 supplementary standard colorimetric observer (10° observer).

The pH of the aqueous extract shall be 7.8 ± 0.5 when determined by the method described in ISO 3071.

The residual matter, after extraction with diethyl ether shall not exceed 0.5 percent.

The alkali solubility shall not exceed 19 percent (m/m) when determined by the method given in ISO 3072.

A-7 Extracts from Textiles — Tests for colour fastness — Part F07: Specification for secondary acetate adjacent fabric

The fabric shall have the following properties.

Mass per unit area: 160 ± 5 g/m².
Whiteness value: \( V_{10} = 86 \pm 2 \)
\( W_{10} = 69 \pm 2 \)
\( T_{10} = -1 \pm 1 \) (i.e. -2 to 0)

Measurements shall be made with specular included in accordance with ISO 105-J01, excluding 0/45 (45/0). Luminance \((Y_{10})\), Whiteness \((W_{10})\) and Tint \((T'_{10})\) values shall be calculated using CIE standard illuminant D\(^6\) and CIE 1964 supplementary standard colorimetric observer (10° observer).

The pH of the aqueous extract shall be 7 ± 0.5 when determined by the method described in ISO 3071.

A-8 Extracts from Textiles — Tests for colour fastness — Part J01: General principles for measurement of surface colour

A-8.1 Principle

Materials of an opaque or nearly opaque nature (but not translucent) are measured by reflectance methods in order to obtain a numerical representation of the colour of the specimen.

NOTES: 1 Proper equipment set-up, standardization of the colour measuring instrument and proper presentation of the test specimens to the instrument are required to achieve consistent, reliable and meaningful reflectance measurement results.

2 In general, instrumental colour measurement procedures are dictated by the type of specimen to be measured and the instrument with which it will be measured. Many types of colour measuring instrumentation are available, differing in such features as area-of-view, illumination method, and geometry. The user is cautioned that conflicting results may be obtained on comparisons of data acquired on instruments of different designs.
A-8.2 Apparatus

A-8.2.1 Reflectance colour measuring instrument, for illuminating a specimen and measuring the amount of light which is reflected from the surface of the specimen. Illumination is usually polychromatic (white light); however monochromatic mode is acceptable for non-fluorescent specimens. Reflectance colour measuring instruments may be broadly divided into two groups:

a) Spectrophotometers (typically diffuse/0, using polychromatic illumination) separate and measure the spectrum of light reflected from the specimen relative to a reference white at regular intervals (wavelength intervals of 5 nm, 10 nm and 20 nm are most common). These data may be used to calculate the desired tristimulus values (X, Y, Z) for any given illuminant and observer. Some spectrophotometers (typically 0/diffuse) illuminate the sample with monochromatic light and measure the amount of light reflected from the surface as the sample is illuminated at regular wavelength intervals.

b) Colorimeters measure the tristimulus values (X, Y, Z) directly through broadband filters which are designed to produce colorimetric values for one illuminant and observer (typically C/2). Measurement of reflectance factors at specific wavelengths is not possible with a colorimeter.

Diffuse/0 (sphere) instruments illuminate the specimen indirectly when the specimen is placed against a port opening into a diffusely illuminated sphere and view the specimen at an angle between 0° and 10° from the perpendicular. This arrangement is designed to capture all light reflected from the specimen. Some sphere instruments with a viewing angle greater than 0° include a specular port which permits the inclusion of exclusion of the specular reflectance.

0/diffuse (sphere) instruments are similar, but the path of illumination and viewing are reversed. This method illuminates the sample at an angle between 0° and 10° and measures the amount of light reflected from the surface into the sphere.

Instruments with 45/0 (or 0/45) geometry illuminate the specimen at the first angle and view the specimen at the second. These two geometries can be either circumferential (viewing or illuminating at 45 to the specimen in a complete circle) or directional. For most textile samples, either 45/0 or 0/45 yield equivalent results.

A-8.2.2 White calibrated standard, with which to standardize the instrument. The colorimetric values for this calibration standard are stored in the instrument or the software and require only that a specific standard be used to standardize the instrument. The correct white standard is usually identified with a serial number.

A-8.2.3 Black standard, required for some instruments. It may be of zero reflectance (a light trap) or it may be calibrated, in which case the comments in A-8.2.2 shall apply.

A-8.3 Procedure

A-8.3.1 General

a) Collect and prepare specimen, noting any special sampling and/or conditioning procedures that may be required as described in A-8.3.3.

b) Standardize instrument according to A-8.3.2. Maintain a record of the procedure and the results of any verification standards measured.

c) Present specimen to colour measuring instrument following any special techniques required for the type of material being measured per section A-8.3.4.

d) Measure the colour of the specimen, obtaining the appropriate spectral reflectance factors (or tristimulus values if a colorimeter is used).

e) Calculate colorimetric values, if required, as described in clause A-8.4,
A-8.3.2 Standardization

Proper standardization of any colour measuring instrument is necessary in order to achieve more precise and accurate results. While different types of instruments require varying methods of standardization/there are common principles which shall be observed.

In general, instrument standardization involves measuring a clean white surface of known reflectance factors and calculating (through software built into the instrument or computer program) a series of correction factors which will be applied to subsequent measurements. Some instruments also require a black tile (or light trap), and possibly a grey tile. Each of these materials shall be maintained in its original clean, unscratched condition. Refer to the specific manufacturer’s recommendations for cleaning instructions.

The frequency with which this standardization is performed depends on many factors including the type of instrument, the environmental conditions in which the instrument operates, and the required accuracy of the results. For most applications, an interval of 2 h to 4 h is acceptable.

Once the standardization step has been performed, it is important to verify the success of the procedure by measuring some coloured materials (verification standards) and comparing the resulting colorimetric values to the original values for these materials. If the measured values do not fall within an acceptable variation from their original values, the standardization is not considered valid. The number of verification standards and the acceptability limits depend on user requirements, but are typically 1 to 3 standards and an acceptance limit of 0.20 AECMC(2:1)D65/10 units.

A-8.3.3 Sampling

All measurements taken on colour measuring instrumentation involve "sampling". The area-of-view of the instrument, the number of presentations averaged to produce a single measurement, the difficulty of presenting the specimen to the instrument, and the accuracy with which the sample represents the object of concern (garment, roll, dyelot, etc.) all play important parts in achieving meaningful and reproducible results.

A-8.3.4 Specimen preparation

The ideal specimen to measure is a rigid, non-textured, inert, opaque specimen of uniform colour. Such ideal specimens do not exist in textiles, so it becomes necessary to employ techniques and practices when measuring most textile materials which eliminate or reduce to acceptable levels the effect any specimen characteristics have on the instrumental colour measurement. Specific procedures and techniques for handling specimens which meet the following characteristics are presented in annex A.

a) Fluorescence of the specimen (from dyes or fluorescent whitening agents [FW As]) will influence the results depending on the amount of fluorescent material present and the amount and quality of ultraviolet and visible energy in the instrument light source. Results may be particularly hard to duplicate between instruments that do not have methods for calibrating the UV content. Example materials are white or lightly coloured materials treated with FW As.

b) Moisture content of textile materials can affect their colour and appearance characteristics. The amount of conditioning time necessary to achieve a stable moisture state varies with fibre, fabric construction, dyes and surrounding conditions. Examples of materials the colour of which are typically affected by moisture content are cotton and viscose materials.

c) Non-rigid specimens tend to protrude (or “pillow”) into the viewing port of instruments. The amount of intrusion may vary depending on number of layers, softness of material and the backing pressure applied to mount the specimen. Variations in the amount of intrusion will result in significant deviations in the resulting colour measurement which are non-reproducible. Examples of these materials are fibre, yam, knits, and layers of lightweight fabric.
d) Non-opaque specimens allow some light to pass through the material during measurement. Most textile materials, by nature of their structure, fit this category. During measurement, any light which passes through the material to reach the backing plate (or escape from the instrument) will yield false results. Examples of these materials are knits, lightweight materials and fibres.

e) Sensitivity of the specimen to light (photochromism) and/or heat (thermochromism) results in non-reproducible results, depending on the degree of sensitivity and the amount of time the specimen is exposed to undesirable conditions.

The photochromic properties of a specimen may be determined according to ISO 105-B05 : 1993.

f) Size of the specimen is important in obtaining a representative measurement by the instrument. When the specimen is too small for normal measurement, special techniques may be required to achieve a proper colour measurement.

g) Surface texture of the specimen (including pile lay, twill, gloss and lustre) affects the results of the colour measurement. The colour measurements of specimens with such physical characteristics are affected in different ways depending on the geometry of the instrument. Results between instruments of different geometries may be non-reproducible. Examples of these types of specimens are carpet, corduroy and wound yarn.

h) Variation in colour (non-uniformity) within the specimen, as related to the area-of-view of the instrument, can cause non-reproducible results. Examples are denim and leathers.

A-8.4 Method of calculation

Most calculations of colorimetric nature are performed by the software being used to operate the colour measuring instrument. In normal cases of reference to this method it will not be necessary for the user to perform these calculations, however they are described here as a means of reference and standardization for those who may need to perform such calculations.

A-8.4.1 Tristimulus values

The tristimulus values \(X, Y, Z\) are derived from spectral data and are the basis for all colorimetric calculations. The exact \(X, Y, Z\) values derived from a set of spectral data depend on several factors including the wavelength range and interval of measurement and the user's choice of illuminant/observer functions used in the calculation.

A-8.4.2 CIE 1976 \(L^*, a^*, b^*, C_{ab}, h_{ab}\)

Calculate the \(L^*, a^*, b^*, C_{ab}, h_{ab}\) values from the \(X, Y, Z\) tristimulus values for both the standard and sample as follows:

\[
L^* = 116(Y/Y_n)^{1/3} - 16 \quad \text{if} \quad Y/Y_n > 0.008856
\]

\[
L^* = 903.3(Y/Y_n) \quad \text{if} \quad Y/Y_n < 0.008856
\]

\[
a^* = 500[(X/X_n) - f(Y/Y_n)]
\]

\[
b^* = 200[f(Y/Y_n) - f(Z/Z_n)]
\]
where:

\[
\frac{(X/X_n)}{(X/X_n)^{1/3}} \quad \text{if } X/X_n > 0,008\,856
\]

or

\[
f(X/X_n) = 7,787 \ (X/X_n) \pm 16/116 \quad \text{if } X/X_n \leq 0,008\,856
\]

\[
f(Y/Y_n) = (Y/Y_n)^{1/3} \quad \text{if } Y/Y_n > 0,008\,856
\]

or

\[
f(Y/Y_n) = 7,787 \ (Y/Y_n) \pm 16/116 \quad \text{if } Y/Y_n \leq 0,008\,856
\]

\[
f(Z/Z_n) = (Z/Z_n)^{1/3} \quad \text{if } Z/Z_n > 0,008\,856
\]

or

\[
f(Z/Z_n) = 7,787 \ (Z/Z_n) \pm 16/116 \quad \text{if } Z/Z_n \leq 0,008\,856
\]

\[
Cap = (a^* \pm b^*)^{1/2}
\]

\[
h_{ab} = \arctan(b^*/a^*) \text{ expressed on a } 0^\circ \text{ to } 360^\circ \text{ scale with the } a^* \text{ positive semi-axis being } 0^\circ \text{ and the } b^* \text{ positive semi-axis at } 90^\circ.
\]

Thus

If \( a^* > 0 \) and \( b^* > 0 \), \( 0^\circ < h_{ab} < 90^\circ \)

If \( a^* < 0 \) and \( b^* > 0 \), \( 90^\circ < h_{ab} < 180^\circ \)

If \( a^* < 0 \) and \( b^* < 0 \), \( 180^\circ < h_{ab} < 270^\circ \)

If \( a^* > 0 \) and \( b^* < 0 \), \( 270^\circ < h_{ab} < 360^\circ \)

for these equations, \( X_n, Y_n \) and \( Z_n \) are the tristimulus values of the illuminant. For daylight the preferred illuminant/observer combination is \( D_6/10 \).

Table 1 gives the tristimulus values for all illuminant/observer combinations.
Table 1 - Tristimulus values for illuminant/observer combinations

(Clause A-8.4.2)

<table>
<thead>
<tr>
<th>Illuminant/observer combinations</th>
<th>Tristimulus values</th>
<th>( X_n )</th>
<th>( Y_n )</th>
<th>( Z_n )</th>
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<td>A/10°</td>
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<td>D75/10</td>
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<td>94,811</td>
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<td>F2/10° (cool white fluorescent 4 230 K)</td>
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<td>F7/10° (daylight fluorescent 6 500 K)</td>
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<td>F11/10° (ultralume 4 000 K and TL84)</td>
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<td></td>
<td></td>
<td>103,863</td>
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<td>Two degree observer</td>
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<td>F2/2° (cool white fluorescent 4 230 K)</td>
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<td>64,350</td>
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## NATIONAL ANNEX B
(National Foreword)

### COMMITTEE COMPOSITION

Chemical Methods of Test Sectional Committee, TXD 05

<table>
<thead>
<tr>
<th>Organization</th>
<th>Representative(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textiles Committee, Mumbai</td>
<td>DR G. S. NADIGAR (Chairman)</td>
</tr>
<tr>
<td>Ahmedabad Textile Industry's Research Association, Ahmedabad</td>
<td>Shri E. VISHNANAGARAM (Alternate)</td>
</tr>
<tr>
<td>Bapuji Institute of Engineering &amp; Technology, Davangere</td>
<td>Dr H. L VIJAYKUMAR BABU (Alternate)</td>
</tr>
<tr>
<td>Central Institute for Research on Cotton Technology, Mumbai</td>
<td>Dr (Miss) C. R. RAJE</td>
</tr>
<tr>
<td>Central Pollution Control Board, Delhi</td>
<td>Dr R. H. BALASUBRAMANYA (Alternate)</td>
</tr>
<tr>
<td>Clariant (India) Ltd, Mumbai</td>
<td>Dr M. Q. ANSARI</td>
</tr>
<tr>
<td>Directorate of Standardization, Department of Defence Production and Supplies, New Delhi</td>
<td>Shri AJAY AGGARWAI (Alternate)</td>
</tr>
<tr>
<td>Indian Institute of Carpet Technology, Bhadohi (U.P.)</td>
<td>Dr V. G. NAYAK</td>
</tr>
<tr>
<td>Indian Jute Industries' Research Association, Kolkata</td>
<td>LT COL (Dr) R. SHRIVASTAVA</td>
</tr>
<tr>
<td>Jaysheee Textiles, Rishra</td>
<td>LT COL B. MANJUNATH (Alternate)</td>
</tr>
<tr>
<td>L N. Chemical Industries, Mumbai Manikial Verma</td>
<td>PROF (Dr) K. K. GOSWAMI</td>
</tr>
<tr>
<td>Textile Institute, Bhiwara Man-Made Textile</td>
<td>SHRIMATI BETTY DAS GUPTA (Alternate)</td>
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<tr>
<td>Research Association, Surat</td>
<td>Shri N. C SOM</td>
</tr>
<tr>
<td>Ministry of Defence (DGQA), New Delhi</td>
<td>Shri ABHIY NAIR</td>
</tr>
<tr>
<td>Ministry of Defence (R&amp;D), New Delhi Office of the Textile Commissioner, Mumbai</td>
<td>Shri PAWAN SHARMA (Alternate)</td>
</tr>
<tr>
<td>&amp; Weaving Mills Ltd, Bhiwara</td>
<td>Shri KETAN L. GANDHI</td>
</tr>
<tr>
<td>Reliance Industries Ltd, Mumbai</td>
<td>Dr N. K. MATHUR</td>
</tr>
<tr>
<td>SNTD Women's University, Mumbai</td>
<td>DR SANDEEP R. NAIK</td>
</tr>
<tr>
<td>Suditi Industries Ltd, Navi Mumbai</td>
<td>Shri M. G. PATEL (Alternate)</td>
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<tr>
<td>Sunil Industries Ltd, Mumbai</td>
<td>Shri P. P. NAIDU</td>
</tr>
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<td>Textiles &amp; Engineering Institute, Ichalkaranji, District Kohlapur</td>
<td>Shri RAMA YADAV (Alternate)</td>
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<td>Shri S. C JAIN</td>
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<td>Shri R. A. LAL</td>
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<tr>
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<td>Shri VINOD G. LATH</td>
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<td>Shri RAMESH KHANNA (Alternate)</td>
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<td>PROF S. K. LAGA</td>
</tr>
<tr>
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<td>PROF S.S.CHINCHWADE (Alternate)</td>
</tr>
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Organization

The Bombay Millowners’ Association, Mumbai
The Bombay Textile Research Association, Mumbai
The South India Textile Research Association, Coimbatore
The Synthetics & Art Silk Mills’ Research Association, Mumbai
Tex-n-Lab, Thane
Veermata Jijabai Technological Institute, Mumbai
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SHRI M. S. VERMA, Director and Head (Textiles) [Representing Director General (Ex-officio)]

Member Secretary
SHRI M. S. VERMA
Director and Head (Textiles), BIS
Technical Corrigendum 1 to International Standard ISO 105-CQ8:2Q01 was prepared by Technical Committee ISO/TC 38, Textiles, Subcommittee SC 1, Tests for coloured textiles and colorants.

Page 1

The Scope now reads as follows:

“This part of ISO 105 specifies methods for determining the resistance of the colour of textiles of all kinds and in all forms to domestic and commercial laundering procedures used for normal household articles using a reference detergent incorporating a Sow temperature bleach activator.

The colour loss and staining resulting from desorption and/or abrasive action in one single test closely approximates to one domestic or commercial laundering.
These methods do not reflect the effect of optical brighteners present in some commercial washing products.
Annex A of this procedure incorporates the use of ECE\(^1\) non-phosphate reference detergent, sodium perborate tetrahydrate and the bleach activator tetra-acetylene diamine (TAED). An alternative test procedure using the AATCC 1993 Zero Phosphate Reference Detergent (without optical brightener) and incorporating sodium perborate monohydrate and the bleach activator, sodium nonanoyloxybenzene sulfonate (SNOBS) is currently under development.

These methods are designed for the detergents and bleach systems given. Other detergents and bleach systems may require different conditions and levels of ingredients.”

---

\(^1\) European Colourfastness Establishment (ECE), BAM, Unter den Eichen 87, D-12203, Berlin, Germany.
Bureau of Indian Standards

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This Indian Standard has been developed from Doc: No. TXD 05 (0810).

Amendments issued Since Publication

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<th>Date of Issue</th>
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