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Tests for colour fastness of textiles — Seventh series

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FOREWORD

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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.

International Standard ISO 105/VII was drawn up by Technical Committee ISO/TC 38, *Textiles,* and circulated to the Member Bodies in April 1973.

It has been approved by the Member Bodies of the following countries :

Australia
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* approved only part 2 of the document.

The Member Bodies of the following countries expressed disapproval of part 1 of the document on technical grounds :

Czechoslovakia
France
Germany

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Tests for colour fastness of textiles – Seventh series

PART 1

COLOUR FASTNESS TO BURNT GAS FUMES

1 SCOPE AND FIELD OF APPLICATION

1.1 This method is intended for assessing the resistance of the colour of textiles of all kinds and in all forms except loose fibres, when exposed to atmospheric oxides of nitrogen as derived from the combustion of butane (C.P.) gas.

1.2 This method may be used for rating colour fastness of dyes by applying the dye to textiles by a specified procedure and at a specified depth of colour and testing the dyed textiles.

2 PRINCIPLE

A specimen of the textile and the test control fabric are exposed simultaneously to oxides of nitrogen from burnt gas fumes until the control shows a change in colour corresponding to that of the standard of fading. The change in colour of the specimen is assessed with the standard grey scale for assessing change in colour. If no colour change is observed in the specimen after one exposure period or cycle, exposure may be continued for either a specified number of periods or for the number of periods required to produce a specified amount of colour change in the specimen.

3 APPARATUS AND MATERIALS

3.1 Exposure chamber (see 8.1).

3.2 Test control (see 8.2).

3.3 Standard of fading (see 8.2).

3.4 Grey scale for assessing change in colour.[1]

3.5 Butane (C.P.) gas (see 8.3).

3.6 Urea solution (see 8.4).

3.7 If required, **perchloroethylene, Stoddard Solvent,** or **trichloroethylene** (see 4.4 and 8.5).

3.8 If required, **standard detergent** (see 4.5 and 8.6).

4 SPECIMEN

4.1 If the textile to be tested is a fabric, use a specimen approximately 100 mm × 40 mm.

4.2 If the textile to be tested is yarn, knit it into fabric and use a specimen 100 mm × 40 mm.

4.3 For fastness to oxides of nitrogen in storage or use, use a specimen of the original fabric.

4.4 For fastness to oxides of nitrogen after dry cleaning (see 8.5) immerse one specimen in cold Stoddard Solvent for 10 min, squeeze, and allow to dry in the air. Immerse one specimen in cold perchloroethylene for 10 min, squeeze and allow to dry in the air. If desired trichloroethylene may be substituted for perchloroethylene. Retain a specimen after dry cleaning and before testing to compare with the tested specimen.

4.5 For fastness to oxides of nitrogen after washing (see 8.5), unless a specific wash-test is specified, wash the test specimen in a detergent solution (see 8.6) (containing 5 g of AATCC standard detergent WOB per litre of water of approximately zero hardness) for 10 min at 40 °C, rinse in warm water and allow to dry in the air. Retain a specimen after washing and before testing to compare with the tested specimen.

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[1] See ISO/R 105/I, Parts 1 and 2.

5 PROCEDURE

5.1 Freely suspend the test specimen and a piece of the test control in the test chamber so that they are not in contact with each other and do not come into direct contact with any hot metallic surface. Light the gas burner (see 8.3) and adjust the flame and ventilating equipment so that the temperature in the chamber does not exceed 60 °C (see 8.7 and 8.8). Keep the specimens in the chamber until the test control shows a change in colour corresponding with that of the standard of fading, when compared in daylight or equivalent artificial illumination (see ISO/R 105/I, Part 1, sub-clause 12.1).

5.2 Remove the test specimens from the test chamber and immediately make a preliminary assessment of change in colour by the use of the grey scale for change in colour.

5.3 Those specimens showing a colour change, a piece of each of their original specimens, and the test control shall, without delay, be plunged into the buffered urea solution (see 8.4) for 5 min. They shall be squeezed out, thoroughly rinsed in water, and dried in air at a temperature not above 60 °C. When dry, assess the change of colour of the specimen against the portion of the original textile which has been treated with buffered urea solution, with the grey scale. If retained, store in the dark.

5.4 After the first cycle, return to the test chamber any specimens which do not show a colour change and which are not treated with the buffered urea solution, along with a fresh piece of the test control, and continue the test until the second test control shows a change in colour corresponding to that of the standard of fading.

5.5 Cycles may be repeated for either a specified number of cycles or until the specimens show a specified amount of colour change.

6 EVALUATION AND CLASSIFICATION

6.1 Repeat the procedure as often as necessary or desired to disclose the number of exposure periods (cycles) required to produce an appreciable alteration of shade. After each exposure period, remove the specimens from the chamber and immediately compare them with the respective originals.

6.2 The effect on the colour of the test specimens after any desired number of cycles can be expressed and defined by reference to the grey scale for colour change.

7 TEST REPORT

Report the class number for each specimen and the number of cycles to which it was exposed. Report the average temperature employed and, if humidity was increased, report the method employed.

8 NOTES

8.1 Exposure chamber

8.1.1 The exposure chamber may be of variable construction but must provide an enclosure in which test specimens can be exposed in an atmosphere of air which has passed over the burner and contains the by-products of combustion from a lighted gas burner. The apparatus shall be equipped with a suitable means of supporting the test specimens so that there is a free circulation of the atmosphere around the specimens and so that only a minimum amount of the specimen at the point of its suspension is in direct contact with any hot metallic surface. Either a motor-driven fan to move the air around in the test chamber or a motor-driven rotating specimen rack shall be employed in order to ensure as nearly as possible that all specimens are exposed to the same conditions of gas concentration, temperature and humidity.

Adjustable vents or dampers in the top of the unit together with the height of the flame of the gas burner shall be used to regulate the temperature of the exposure chamber, but temperature and humidity will vary with that of the room in which the exposure chamber is being operated.

8.1.2 Several forms of suitable apparatus are illustrated in the *American Dyestuff Reporter*, July 22, 1940, pages 368-9. Blueprints of a suitable apparatus may be purchased from AATCC, P.O. Box 12215, Research Triangle Park, N.C. 27709, U.S.A.

8.1.3 The US Testing Co., 1415 Park Ave., Hoboken, N.J., U.S.A., in co-operation with AATCC, has developed a gas-fading apparatus which is suitable for large-scale testing and is available for purchase. The unit collects the fumes from a safety-type Electrolux burner which is located in a lower chamber as shown in the figure. In order to ensure uniform fading of the test specimens, the arms on which they are hung are revolved at the rate of 2 rev/min by a motor drive, thus ensuring that all specimens are exposed under identical controlled conditions. Since the test apparatus has been primarily designed for more accurate control work, it is recommended that the temperature be adjusted so as to complete one test in 7 to 16 h.

8.2 Test control and standard of fading

8.2.1 The test control fabric is secondary cellulose acetate uniformly dyed in an open width dyeing machine with 0,4 % (on mass of fabric) Celliton Blue FFRN (Colour Index Disperse Blue 3) in a dye-bath containing 1 g/l of a neutral non-ionic dispersing agent at a liquor ratio of 10 : 1.

The dyeing begins at 40 °C and the temperature is raised to 80 °C within 30 min. The dyeing is continued for a further 60 min. The fabric is rinsed in cold water and dried.

The colour co-ordinates of this dyeing are $x = 0{,}1988$, $y = 0{,}1904$, $Y = 23{,}20$.

The tolerance may be 2 AN (40) units maximum.

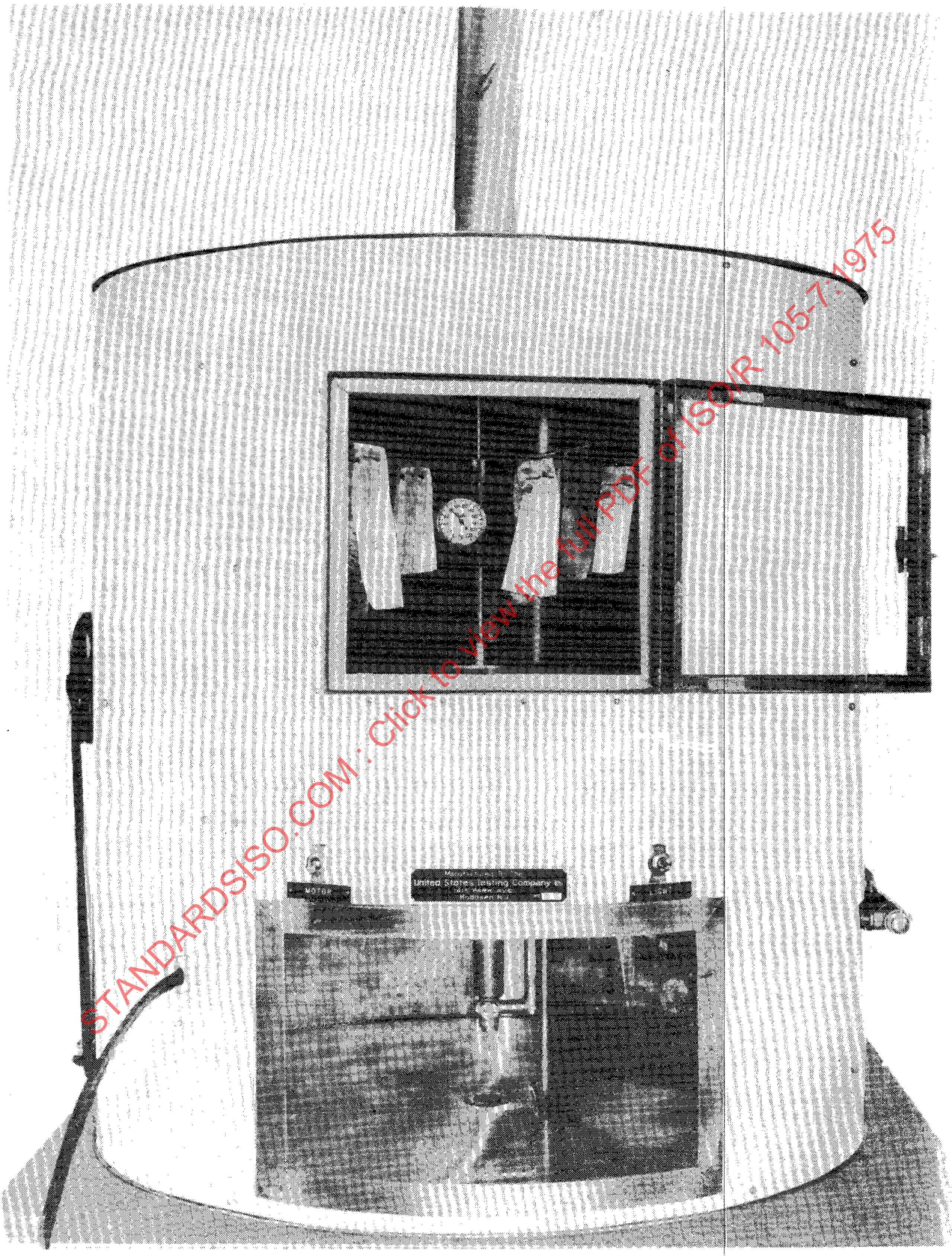

FIGURE – **Gas-fading apparatus for large-scale testing**

8.2.2 Pieces of the original lot of control fabric were hung in air in three separate places in Southern New Jersey, U.S.A., for 6 months. It was assumed that the atmosphere in these places contained an average content of oxides of nitrogen. At the end of the exposure period, samples from the three locations were assembled and compared with the original material. All had changed about equally, being decidedly duller and redder than the original. The faded shade was then matched with vat dyes on cellulose acetate satin and this became the original standard of fading for that lot of control fabric. This produced a standard of fading which was more permanent than the exposed pieces of the control fabric which would have continued to change with even very small amounts of oxides of nitrogen.

8.2.3 Since different lots and sources of both the dyestuff and undyed fabric will produce variations in both the original shade and its fading rate, it is therefore necessary to establish accurately a new standard of fading for each dyed lot of control fabric so that comparable test results can be obtained when using different lots of the control and their respective standards of fading. In conducting tests, only the standard of fading applicable to that lot of control fabric may be used.

8.2.4 The standard of fading is a fabric of similar appearance dyed to match a faded specimen of the test control. Both the test control and the standard of fading can be obtained from the national standards bodies.

8.2.5 Both the control fabric and the standard of fading must be kept in suitable containers or enclosures to protect them from possible exposure and colour change to oxides of nitrogen and other contaminants which might be present in the atmosphere during transportation and storage.

8.2.6 The control fabrics are also sensitive to other atmospheric contaminants such as ozone. Their fading rates will vary considerably at different humidities and temperatures and their use in natural conditions or end-use testing as a measure of exposure to ozone is not recommended. The colour change produced on the controls will reflect the combined effects of the atmospheric contaminants present and temperature-humidity variations — not just the effects of exposure to oxides of nitrogen.

8.2.7 A sealed unit of test control fabric comprising 18,3 m (20 yd) of ribbon 25,4 mm (1 in) wide with a specific lot number indicated and a specimen of the standard of fading for that lot of control fabric is available as Control Sample No. 1 from Test Fabrics, Inc., P.O. Box 53, 200 Blackford Ave., Middlesex, N.J. 08846, U.S.A.

8.3 Gas

Use butane (C.P.) gas to supply the burner. Any gas burner may be used and either a yellow luminous or blue-green flame is suitable, though the latter is to be preferred in order to minimize the formation of soot. A wire screen placed above the flame at a distance which causes it to be heated somewhere between a red and white heat will increase the percentage of oxides of nitrogen and will thereby accelerate the fading of the control and samples. Brass, iron, Monel alloy and stainless steel screens give practically the same results.

8.4 Urea solution

10 g/l of urea ($NH_2 - CO - NH_2$), buffered to pH 7 by the addition of 0,4 g of sodium dihydrogen orthophosphate dihydrate ($NaH_2PO_4.2H_2O$) and 2,5 g of disodium hydrogen orthophosphate dodecahydrate ($Na_2HPO_4.12H_2O$) and 0,1 g or less of a rapid wetting surface-active agent, for example sodium dioctyl sulphosuccinate.

8.5 Dry-cleaning and washing test specimens

All the inhibitors available at present are soluble to some extent in water and therefore tend to be removed by washing. These inhibitors are in general not soluble in the ordinary dry-cleaning solvents, and fabrics treated with suitable inhibitors should withstand several dry-cleanings without losing their resistance to gas fading (if the dry-cleaning operation does not include spotting or sponging with water). The inhibitors also tend to lose their efficiency if the fabrics come into frequent contact with perspiration.

8.6 Detergent

AATCC standard detergent WOB with the following composition is available from AATCC, P.O. Box 12215, Research Triangle Park, N.C. 27709, U.S.A. :

General characteristics

Low sudsing laundry detergent

Anionic with added non-ionic

Bio-degradable

Fully built solution pH10

High density granule (5 oz/cup = 0,6 g/ml)

Nominal composition	%
Linear alkylate sulphonate — sodium salt (LAS)	14,0
Alcohol ethoxylate	2,3
Soap — high molecular mass	2,5
Sodium tripolyphosphate	48,0
Sodium silicate (SiO_2/Na_2O = 2,0)	9,7
Sodium sulphate	15,4
CMC (carboxy methyl cellulose)	0,25
Moisture	7,85
	100,00

LAS – Sodium salt

Made from linear alkylate of the following characteristics :

Approximate alkylate chain length distribution

C_{10} – 10 %

C_{11} – 35 %

C_{12} – 30 % Average C = 11,8

C_{13} – 20 %

C_{14} – 5 %

2-phenyl isomer distribution – 30 % approximately

Approximate molecular mass – 244

Ethoxylated fatty alcohol

Made from linear alcohol with the following characteristics :

Approximate chain length distribution

C_{10} – trace

C_{12} – 66 %

C_{14} – 26 % Average hydroxyl value = 285

C_{16} – 7 %

C_{18} – trace

Ethoxylated to give $RO(C_2H_4O)_nH$

$n = 6$ average

Hydroxyl value = 122 approximately

8.7 Temperature for testing

Other things being equal, the fading of the specimens will vary according to the temperature in the exposure chamber, which in turn depends upon the amount of gas consumed in a given period. Exposure for 8 to 12 h at 60 °C may cause as much colour destruction as exposure for 96 h at 21 to 27 °C. Apart from this, the temperature may vary somewhat in different parts of the exposure chamber from time to time.

8.8 Humidity for testing

The fading of dyes by oxides of nitrogen on acetate, triacetate and polyester will occur at low relative humidities as would be obtained in the conventional chamber at temperatures approaching 60 °C. For other fibres such as nylon, rayon or cotton it is necessary to use high humidities in order to produce results which correlate with service performance. A suggested procedure for raising the level of humidity in the chamber is to place containers of water on the floor surface of the chamber. If the humidity is raised by this or any other procedure, this shall be noted in the report of the test results.

8.9 Heat by ironing

When an acetate fabric is pressed with an iron which is hot enough to remove all wrinkles, there is a danger of sealing the surface of the fabric which would increase the resistance to gas fading. This technique is not conducive to accurate test results and should be avoided on fabrics of this type.

PART 2

METHOD OF TEST FOR DETECTION AND ASSESSMENT OF PHOTOCHROMISM

1 SCOPE AND FIELD OF APPLICATION

This method is intended for detecting and assessing change in colour after brief exposure to light of coloured textiles which change in colour on exposure to light, but which virtually return to their original shade when stored in the dark.

2 PRINCIPLE

A specimen of the textile is exposed to light of high intensity for a time much shorter than that necessary to cause a permanent change. The change in colour of the specimen is assessed immediately after exposure with the standard grey scale : the specimen is then stored in the dark and assessed again.

3 APPARATUS AND MATERIALS

3.1 The standards for this test are Standard No. 1[1] or Standard No. L2[2] used in the methods for determining colour fastness to light.

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

A filter is placed between the light source and the specimens and standards so that the ultraviolet spectrum is steadily reduced becoming zero at 300 to 320 nm. Glass with the same transmission characteristics as that used in the test "Colour fastness to light — Daylight"[1] is suitable.

The equipment described in the test for determining colour fastness to artificial light is considered most satisfactory.[3]

3.3 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.

3.4 Grey scale for assessing change in colour.[4]

4 SPECIMEN

4.1 An area of the textile not less than 45 mm X 10 mm is required. The specimen may be a strip of cloth, yarns wound close together on a card or laid parallel and fastened on a card, or a mat of fibres combed and compressed to give a uniform surface and fastened on a card.

4.2 To facilitate handling, the specimen and a similar strip of the standard may be mounted on cards.

5 PROCEDURE

5.1 Cover approximately one-half of the strip of Standard 1 or L2 (see 3.1) with opaque cardboard (see 3.3).

5.2 Expose the partially covered Standard 1 or Standard L2 continuously to a xenon arc fading lamp at moderate effective humidity[2] until the contrast between the original and the exposed portion of the standard is equal to grey scale 4. Determine the time necessary to produce this change. It will only be necessary to repeat this operation if exposure conditions change significantly.

5.3 Cover approximately one-half of the specimen (see 4.1) with opaque cardboard (see 3.3).

5.4 Expose the specimen in the same position and under the same conditions as in 5.2 for one-quarter of the time necessary to produce a grey scale 4 fade on Standard 1 or one twenty-fifth of the time necessary to produce a grey scale 4 fade on Standard L2 (see 5.2).

5.5 Remove the specimen from the source of light. Immediately remove the cover from the specimen and assess the contrast between the original and the exposed portions with the grey scale.

5.6 If the contrast is not greater than grey scale 4, the specimen is not photochromic and further examination is not necessary.

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[1] See ISO/R 105/I, Part 11.

[2] See ISO 105/VI, Part 2.

[3] See ISO/R 105/V, Part 2.

[4] See ISO/R 105/I, Parts 1 and 2.