

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION R 105/V

TESTS FOR COLOUR FASTNESS OF TEXTILES

FIFTH SERIES

1st EDITION

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BRIEF HISTORY

The ISO Recommendation R 105/V, *Tests for colour fastness of textiles – Fifth series*, was drawn up by Technical Committee ISO/TC 38, *Textiles*, the Secretariat of which is held by the British Standards Institution (BSI).

Work on this question led in 1966 to the adoption of a Draft ISO Recommendation.

In April 1967, this Draft ISO Recommendation (No. 1222) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Austria	India	Romania
Belgium	Iran	South Africa, Rep. of
Brazil	Israel	Spain
Canada	Japan	Sweden
Czechoslovakia	Korea, Rep. of	Switzerland
Denmark	Netherlands	Turkey
France	New Zealand	~~United Kingdom~~
Germany	Norway	U.S.A.
Hungary	Portugal	U.S.S.R.

^{Two} ^{ies}
One Member Body opposed the approval of the Draft :

Italy

*United Kingdom**

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in March 1969, to accept it as an ISO RECOMMENDATION.

() In the light of changes made subsequently, the UK Member Body approved the final text.*
~~The UK Member Body~~

copy of the proposed Enactment sent to Mr Mundell

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TESTS FOR COLOUR FASTNESS OF TEXTILES**FIFTH SERIES****PART I****COLOUR FASTNESS TO VULCANIZING (OPEN STEAM)****1. PURPOSE AND SCOPE**

This method is intended for assessing the resistance of the colour of textiles, of all kinds and in all forms, to the action of a typical rubber compound such as may be used in the proofing industry, and to its decomposition products during vulcanization in open steam, either

- (a) under conditions that prevent live steam from coming into contact with the textile to be tested (Method A), or
- (b) under conditions that allow live steam to infiltrate into the textile to be tested (Method B).

2. PRINCIPLE

A specimen of the textile is heated in live steam in direct contact with an (initially) unvulcanized rubber compound, the textile material being wrapped in either

- (a) sheeting impermeable to steam and water (Method A), or
- (b) undyed bleached cotton cloth but ensuring that live steam is not prevented from infiltration into the specimen (Method B).

The change of colour in the specimen and the staining of undyed cloth are assessed with standard grey scales.

3. APPARATUS AND REAGENTS

- 3.1 *Jacketed autoclave*, capable of holding a steam pressure on both jacket and pan of 3.9 kgf/cm^2 (55 lbf/in^2).
- 3.2 *Stainless steel open-ended tube*, of diameter $40 \pm 3 \text{ mm}$, and wall thickness $2.5 \pm 0.5 \text{ mm}$.

3.3 *Sheet of uncured rubber compound*, 2.5 ± 1.5 mm thick, consisting of the following :

100	parts pale crêpe,
5	parts zinc oxide,
1	part stearic acid,
2	parts sulphur,
1	part mercaptobenzthiazole,
0.2	part diethyldithiocarbamate,
15	parts titanium dioxide,
75	parts barium sulphate.

If it is necessary to transport the sheet, it should be covered with a thin polyethylene film.

3.4 *Undyed cloth* of the same generic kind of fibre as that in the textile to be tested, or that predominating in the case of blends.

3.5 *Undyed bleached cotton*.

3.6 For Method A only (ingress of steam prevented) : *sheeting* which is impermeable to steam and water, for example rubber-proofed fabric sheeting or plastics sheeting such as polyester, capable of withstanding a temperature of 140°C .

3.7 *Grey scales* for assessing change in colour and staining.*

4. SPECIMEN

4.1 Remove any polyethylene film from the sheet of uncured rubber compound and moisten the compound with petroleum spirit.

4.2 If the textile to be tested is fabric, place a specimen $100\text{ mm} \times 40\text{ mm}$ on the sheet of uncured rubber compound. To ensure a uniform degree of adhesion the specimen should be "rolled" on to the rubber with a metal roller.

4.3 If the textile to be tested is yarn, knit it into fabric and use a specimen $100\text{ mm} \times 40\text{ mm}$, or stick a number of lengths flat and side by side onto the rubber to obtain the specified area of the textile for test.

4.4 If the textile to be tested is loose fibre, comb and compress enough of it to form a sheet $100\text{ mm} \times 40\text{ mm}$ and stick this to the rubber sheet.

* See ISO Recommendation R 105/1, *Tests for colour fastness of testiles (First series)* :
 Part 1 : "General principles of testing",
 Part 2 : "Grey scale for assessing change in colour",
 Part 3 : "Grey scale for assessing staining".

5. PROCEDURE

5.1 Wrap the composite specimen round a stainless steel open-ended tube (3.2), rubber face inside.

5.1.1 *For Method A* (ingress of steam prevented) cover the specimen by tightly wrapping with one layer of undyed cloth of the same fibre as the specimen, three layers of undyed bleached cotton cloth and two layers of impermeable sheeting, taking care that the wrapping projects beyond edges of the composite specimen on the tube.

Securely bind the edges with string to prevent ingress of steam.

5.1.2 *For Method B* (ingress of steam permitted), cover the specimen by tightly wrapping with one layer of undyed cloth of the same fibre as the specimen and two layers of undyed bleached cotton cloth.

5.2 Place the tube in the preheated autoclave (3.1) ensuring that the temperature of the jacket is 141 ± 1 °C (2.8 kgf/cm² or 40 lbf/in² steam pressure) and that of the pan 138 ± 1 °C (2.5 kgf/cm² or 35 lbf/in² steam pressure). Carry out the test for 20 minutes.

5.3 Remove the tube, cool in air, remove the wrapping cloths and separate the specimen from the rubber.

5.4 Assess the change in colour of the specimen on the side not in contact with the rubber, and the staining of the wrapping cloth made of the same fibre as the specimen on the side in direct contact with the specimen.

6. REPORT

Report the numerical rating of the specimen for the change in colour and for the staining of the undyed material, stating which method of wrapping has been used (see clauses 5.1.1 and 5.1.2).

7. NOTES

7.1 It should be borne in mind that this test employs a basic rubber compound. Other compounding ingredients are frequently used in production and may have specific effects on colour fastness not revealed by this test.

7.2 If required, report if staining is produced on the sheet of rubber.

PART 2

COLOUR FASTNESS TO ARTIFICIAL LIGHT : XENON ARC LAMP TEST

1. PURPOSE AND SCOPE

This method is intended for assessing the resistance of the colour of textiles of all kinds and in all forms to the action of an artificial light source.

If there is a possibility of the sample being photochromic, then it should be tested for photochromism.

2. PRINCIPLE

A specimen of the textile is exposed under specified conditions, along with eight dyed wool standards, to the light from a xenon arc lamp. The fastness is assessed by comparing the fading of the textile with that of the standards.

3. STANDARDS AND EQUIPMENT

3.1 Standards

- 3.1.1 The standards for this test are blue wool cloths dyed with the dyes listed below. They range from 1 (very low light fastness) to 8 (very high light fastness) (see clause 7.1) each standard being approximately twice as fast as the one numerically below it.*

Fastness rating	Dye
1	Colour Index, 2nd Edition, Acid Blue 104
2	Colour Index, 2nd Edition, Acid Blue 109
3	Colour Index, 2nd Edition, Acid Blue 83
4	Colour Index, 2nd Edition, Acid Blue 121
5	Colour Index, 2nd Edition, Acid Blue 47
6	Colour Index, 2nd Edition, Acid Blue 23
7	Colour Index, 2nd Edition, Solubilised Vat Blue 5
8	Colour Index, 2nd Edition, Solubilised Vat Blue 8

- 3.1.2 The humidity test control is obtained by dyeing of azoic dyes on bleached mercerised cotton cloth (poplin) (see clauses 7.1 and 7.8).

- 3.1.3 Master sets of the standards and the humidity test control are filed in each country for reference.

* See ISO Recommendation R 105/1, *Tests for colour fastness of textiles (First series)* :
Part 11 : "Colour fastness to light – Daylight."

3.2 *Black-panel thermometer* (see clause 7.3).

3.3 *Light source*. The light source is a xenon arc lamp of correlated colour temperature 5500 to 6500 K.

3.4 *Filter*. A filter is placed between the light source and the specimens and standards so that the ultraviolet spectrum is steadily reduced, reaching a lower limit at a wavelength of 310 to 320 nm. Glass with the same transmission characteristics as that used in the test Colour fastness to light – Daylight, is suitable.*

The spectrum of the xenon arc contains an appreciable amount of infra red radiation which can be eliminated by heat filters. The temperature conditions (see clause 3.5) can then be satisfied. The filters should be cleaned regularly to avoid undesirable reduction in light intensity.

3.5 *Exposure chamber*, well ventilated, for exposure of the specimens.

3.5.1 *Normal conditions* (temperate zone). Moderate effective humidity (see clause 7.7) : light fastness of the humidity test control 5, black-panel temperature maximum 45 °C (see clause 7.3).

3.5.2 *Extreme conditions*. For testing sensitivity of specimens to humidity the following extreme conditions are useful :

- low effective humidity : light fastness of the humidity test control 6–7, black-panel temperature maximum 60 °C.
- high effective humidity : light fastness of the humidity test control 3, black-panel temperature maximum 40 °C.

The variation of the light intensity over the area covered by specimens and standards should not exceed 20 %.

3.6 *Opaque cardboard* or other thin opaque material, for example thin sheet aluminium, or cardboard covered with aluminium foil.

3.7 *Grey scale* for assessing change in colour.**

4. SPECIMEN

4.1 Use an area of the textile measuring not less than 100 mm × 45 mm when the several periods of exposure are made side by side on the same specimen, which is the preferred practice. 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 or specimens to be tested and similar strips of the standards may be mounted on a card in an arrangement such as indicated in clause 7.4, for example.

If specimens larger than the standards are exposed, a mask of a neutral grey colour (approximately Munsell N/6) should be used in the assessment covering the surplus area of the specimens, and leaving an area equal to that of the standards open for comparative evaluation.

4.3 The specimens to be tested and the strips of blue scale should be of the same dimensions and of the same shape, to avoid errors in quoting a higher visual contrast between the exposed and covered parts of a specimen larger than the standard. The fabric specimens should be cut so that the longer sides are parallel with the weft.

* See ISO Recommendation R 105/1, *Tests for colour fastness of textiles (First series)* : Part 11 : "Colour fastness to light – Daylight."

** See ISO Recommendation R 105/1, *Tests for colour fastness of textiles (First series)* : Part 1 : "General principles of testing".
Part 2 : "Grey scale for assessing change in colour".

5. PROCEDURE

- 5.1 Humidity control.** Expose partially covered strips of the humidity test control and the standards simultaneously until a contrast is produced on the humidity test control equal to Grade 4 on the grey scale.* Assess the light fastness and, if necessary, adjust the controls on the lamp to give the selected exposure conditions (see clause 3.5).
- 5.2 Exposure of specimens.** Expose the specimen (or group of specimens) and the standards simultaneously under the conditions enumerated in clauses 3.3 to 3.5 in such a manner and for such times as are necessary to evaluate fully the light fastness of each specimen relative to that of the standards, by successively covering the specimens and standards throughout the time of the test (see clause 7.4 for two suggested methods of procedure).
- 5.3 Preliminary assessment of light fastness.** When a change in colour (see clause 7.5) of the specimen under test can just be perceived, note the number of the standard showing a similar change. Alternatively, when a change in colour of standard 3 can just be perceived, assess any change that has occurred in the specimen in comparison with the changes in standards 1, 2 and 3 (see clause 7.6).

Continue to expose after the preliminary assessment as required to evaluate fully the light fastness.

- 5.4 Assessment of light fastness.** Compare the changes in colour of the test specimen with the changes which have occurred in the standard (see clause 7.5). The light fastness of the specimen is the number of the standard which shows similar changes in colour (visual contrast between exposed and unexposed portions of the specimen). If the specimen shows changes in colour approximately half-way between the two standards, an appropriate half-rating, for example 3-4, should be given.
- 5.5** If the colour of the specimen is more fugitive than that of standard 1, a rating of 1 is given.
- 5.6** If the light fastness is 4 or higher, the assessment based on the first perceptible change (see clause 5.3) becomes significant; if this preliminary assessment is 3 or lower, it is included in brackets in the rating.
- For example, a rating of 6 (3) indicates that the specimen changes very slightly in the test when standard 3 just begins to fade, but that on continuing the exposure the resistance to light is equal to that of standard 6.

6. REPORT

Report the numerical rating for light fastness. If this rating is 4 or higher and the preliminary assessment is 3 or lower, report the latter figure in brackets. Report also the exposure conditions and the make of xenon arc lamp used.

* See ISO Recommendation R 105/1, *Tests for colour fastness of textiles (First series)* :
Part 1 : "General principles of testing",
Part 2 : "Grey scale for assessing change in colour".

7. NOTES

- 7.1 Sets of the light fastness standards and samples of the humidity test control may be obtained from the national standards bodies. The former are specially dyed to match a master set of standards in colour and in fading behaviour (see clause 7.8). It has been found that, when repeated dyeings of the dyed standards are made, the amount of dye required to match the previous lot is often different from that originally used. The dyeing strengths would therefore be misleading, and they are intentionally omitted from this listing.
- 7.2 If a glass or water filter is used to eliminate excess infra-red radiation so as to meet the temperature conditions specified in clause 3.5, frequent cleaning must be carried out to avoid unwanted filtering caused by dirt.
- 7.3 The black-panel thermometer should consist of a metal panel measuring at least 45 mm × 100 mm the temperature of which is measured with a thermometer or a thermocouple which has its sensitive portion located in the centre of, and in good contact with, the panel. The side of the panel facing the light source should be black with an infra-red reflectance of less than 5 % throughout the spectrum reaching the specimen. The side of the panel not facing the light source should be thermally isolated.*
- 7.4 Suggested procedures for mounting and testing for light fastness

7.4.1 Method 1

- 7.4.1.1 This method is considered ideal and should be used in cases of dispute. It requires one set of standards for each specimen under test and is, therefore, impracticable when a large number of specimens have to be tested concurrently; in such cases Method 2 (see clause 7.4.2) is suggested.
- 7.4.1.2 Arrange the specimen to be tested and the standards as shown in ISO Recommendation R 105/I, Part 11, Figure 1, with an opaque cover across one-third of the specimen and standards.** Expose to light under the conditions enumerated in clause 3.5. Follow the effect of light by lifting the cover and inspecting the specimen frequently. When a change in colour can just be perceived, note the number of the standard showing a similar change.
- 7.4.1.3 Continue to expose until the contrast between the exposed and the covered portions of the specimen is equal to Grade 4 on the grey scale.*** Cover a second one-third of the specimen and standards with an additional opaque cover.
- 7.4.1.4 Continue to expose, until the contrast between the fully exposed and the unexposed portions is equal to Grade 3 on the grey scale. If standard 7 fades to a contrast equal to Grade 4 on the grey scale before the specimen does, the exposure may be terminated at this stage. When a specimen has a light fastness of 7 or over, it would require unduly long exposure to produce a contrast equal to Grade 3 on the grey scale; moreover, this contrast would be impossible to obtain when the light fastness is 8. Assessments in the region 7 to 8 are made therefore, when the contrast produced on standard 7 is equal to Grade 4 on the grey scale, the time required to produce this contrast being long enough to eliminate any error which might result from inadequate exposure.

* The black-panel thermometers of Atlas Electric Devices Co., 4114 North Ravenswood Avenue, Chicago 13, Illinois, U.S.A. and of Quarzlampen GmbH, Hanau, Germany, are suitable.

** See ISO Recommendation R 105/I, *Tests for colour fastness of textiles (First series)* : Part 11 : "Colour fastness to light – Daylight".

*** See ISO Recommendation R 105/I, *Tests for colour fastness of textiles (First series)* : Part 1 : "General principles of testing", Part 2 : "Grey scale for assessing change in colour".

- 7.4.1.5 **ASSESSMENT OF LIGHT FASTNESS.** The specimen now shows three separate areas : an unexposed area and two areas which have changed in colour to different degrees. Compare these changes with the changes which have occurred in the standards and rate the light fastness as in clauses 5.4 to 5.6.

If two different assessments are obtained at the two different degrees of contrast, the light fastness of the specimen is the arithmetic mean of these two assessments.

7.4.2 Method 2

- 7.4.2.1 This method should be used when a large number of specimens have to be tested concurrently. It enables a number of specimens differing in light fastness to be rated against a single set of standards.
- 7.4.2.2 Arrange the specimens to be tested and the standards as shown in ISO Recommendation R 105/I, Part 11, Figure 2, with card AB covering one quarter of the total length of each specimen and standard.* Expose to light under the conditions enumerated in clause 3.5. Follow the effect of light by lifting the cover periodically and inspecting the standards. When a change in colour in standard 3 can just be perceived, inspect the specimens and rate their light fastness by comparing any change in colour that has occurred with the changes that have occurred in standards 1, 2 and 3.
- 7.4.2.3 Replace the card AB in exactly the same position and continue to expose until a change in colour in standard 4 can just be perceived; at this point fix an additional cover CD in the position shown in Figure 2 of ISO/R 105/I, Part 11, overlapping the first cover.
- 7.4.2.4 Continue to expose until a change in colour in standard 6 can just be perceived; then fix the final cover EF in the position shown in Figure 2 of ISO/R 105/I, Part 11, the other two covers remaining in position. Expose until either
- (a) a contrast is produced on standard 7 equal to the contrast illustrated by Grade 4 on the grey scale,
 - or
 - (b) a contrast equal to Grade 3 on the grey scale has been produced on the most resistant specimen, whichever occurs first. Remove the three covers.
- 7.4.2.5 Compare the changes in colour in the specimens with those of the standards, and rate the light fastness as in clauses 5.4 to 5.6.

- 7.5 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	G = Greener	R = Redder
Y = Yellower	Br. = Brighter	D = Duller

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

W = Weaker Str. = Stronger

* See ISO Recommendation R 105/I, *Tests for colour fastness of textiles (First series)* : Part 11 : "Colour fastness to light - Daylight".