

Australian Standard™

AS 2001.4.B02

Methods of test for textiles

Method 4.B02: Colourfastness tests—Colourfastness to artificial light: Xenon arc fading lamp test (ISO 105-B02:1994, MOD)

PREFACE

This Standard was prepared by the Standards Australia Committee TX-020, Testing of Textiles.

The objective of this Standard is to provide manufacturers and testing bodies with a standard method for determining the resistance of colour in textiles to the action of an artificial light source, in order to give an assurance of light fastness and give results which are suitable for comparison.

The Standard is an adoption with national modifications (see Appendix ZZ) and has been reproduced from ISO 105-B02:1994, *Textiles—Tests for colour fastness—Part B02: Colour fastness to artificial light: Xenon arc fading lamp test* including ISO 105-B02:1994/Amd.1:1998 with national modifications (see Appendix ZZ) and ISO 105-B02:2000/Amd.2:2000, which is adopted with no variation. The ISO Amendments are attached at the end of the ISO document and the affected text is indicated by a marginal bar with the notifier ISO 1 or ISO 2.

Appendix ZZ lists the Australian variations to ISO 105-B02. In the text of this Standard, double marginal bars have been added to the text whenever the requirements of the Standard have been varied to meet Australian requirements.

The textile laboratories in Australia prefer that one reference system is issued, for consistency between laboratories. The majority of laboratories have experience with the European System using references 1 to 8. One system will provide more consistency of results therefore the American system (references L2 to L9) has been deleted for Australian purposes.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the annex or appendix to which they apply. A ‘normative’ annex or appendix is an integral part of a Standard, whereas an ‘informative’ annex or appendix is only for information and guidance.

As this Standard is reproduced from an International Standard, the following applies:

- (a) Its number appears on the cover and title page while the International Standard number appears only on the cover.
- (b) In the source text ‘this part of ISO 105’ should read ‘this Australian Standard’.
- (c) A full point should be substituted for a comma when referring to a decimal marker.

The Committees at the time of publication, are in the process of adopting the International Standards referenced below. AS 2001.4.1—1996 is based on ISO 105-A01. Appendix A of AS 2001.4.1 incorporates Standard reference materials from ISO 105, Parts A02, A03, B01 and the F series. Appendix B is identical to ISO 105-A04, and Appendix C is identical to ISO 105-A05. Appendix D contains Australian modifications to Clauses 8.3, 13.1 and 13.3 of ISO 105-A01. Appendix E is identical to ISO 3696.



The references to International Standards should be replaced by references to the following Australian or Australian/New Zealand Standards, as follows:

<i>Reference to International Standard</i>		<i>Australian Standard</i>	
ISO		AS	
105	Textiles—Tests for colour fastness	2001	Methods of test for textiles
105-A01	Part A01: General principles of testing	2001.4.1	Method 4.1: Colourfastness tests—Definitions and general requirements
105-A02	Part A02: Grey scale for assessing change in colour		
105-A05	Part A05: Method for the instrumental assessment of the change in colour of a test specimen		
105-B01	Part B01: Colour fastness to light: Daylight		
105-B05	Part B05: Detection and assessment of photochromism		
ISO			
3696	Water for analytical laboratory use—Specification and test methods		
CIE			
51	Method for assessing the quality of daylight simulators for colorimetry	—	

CONTENTS

Page

1	SCOPE	1
2	NORMATIVE REFERENCES	1
3	PRINCIPLE	1
4	REFERENCE MATERIALS AND APPARATUS	2
5	TEST SPECIMENS	4
6	EXPOSURE CONDITIONS	5
7	PROCEDURE	5
8	ASSESSMENT OF COLOUR FASTNESS	8
9	TEST REPORT	9

ANNEXES

A	APPARATUS FOR DETERMINING COLOUR FASTNESS WITH AIR-COOLED XENON ARC LAMPS	11
B	APPARATUS FOR DETERMINING COLOUR FASTNESS WITH WATER-COOLED XENON ARC LAMPS	13
C	GENERAL INFORMATION ON COLOUR FASTNESS TO LIGHT	15
	AMENDMENT 1	17
	AMENDMENT 2	20
	APPENDIX ZZ VARIATIONS TO ISO 105-B02:1994 AND ISO 105-B02:1994/ Amd.1:1998 FOR AUSTRALIAN CONDITIONS	25

NOTES

1 Scope

This part of ISO 105 specifies a method intended for determining the resistance of the colour of textiles of all kinds and in all forms to the action of an artificial light source representative of natural daylight (D₆₅). The method is also applicable to white (bleached or optically brightened) textiles.

This method allows the use of two different sets of blue wool references. The results from the two different sets of references may not be identical.

NOTE 1 General information on colour fastness to light is given in annex C.

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 fast-*

1) To be published.

2) To be published. (Revision of ISO 105-B01:1989)

ness — Part A02: Grey scale for assessing change in colour.

ISO 105-A05:—¹⁾, *Textiles — Tests for colour fastness — Part A05: Method for the instrumental assessment of the change in colour of a test specimen.*

ISO 105-B01:—²⁾, *Textiles — Tests for colour fastness — Part B01: Colour fastness to light: Daylight.*

ISO 105-B05:1993, *Textiles — Tests for colour fastness — Part B05: Detection and assessment of photochromism.*

ISO 3696:1987, *Water for analytical laboratory use — Specification and test methods.*

CIE Publication No. 51, *Method for assessing the quality of daylight simulators for colorimetry.*

3 Principle

A specimen of the textile to be tested is exposed to artificial light under prescribed conditions, along with a set of blue wool references. The colour fastness is assessed by comparing the change in colour of the test specimen with that of the references used.

For white (bleached or optically brightened) textiles, the colour fastness is assessed by comparing the change in whiteness of the specimens with that of the reference used.

4 Reference materials and apparatus

4.1 Reference materials

ISO 105
Either of two sets of blue wool references may be used. The results from the two sets of references are not interchangeable.

The colour fastness ratings mentioned in this part of ISO 105 are obtained by comparison with either blue wool references 1 to 8 (preferable in Europe) or blue wool references L2 to L9 (preferable in America).

4.1.1 References 1 to 8

Blue wool references developed and produced in Europe are identified by the numerical designation 1 to 8. These references are blue wool cloths dyed with the dyes listed in table 1. They range from 1 (very low colour fastness) to 8 (very high fastness) so that each higher-numbered reference is approximately twice as fast as the preceding one.

4.1.2 References L2 to L9

Blue wool references developed and produced in the United States are identified by the letter L followed by the numerical designation 2 to 9. These eight references are specially prepared by blending varying

proportions of wool dyed with CI Mordant Blue 1 (Colour Index, third edition, 43830) and wool dyed with CI Solubilized Vat Blue 8 (Colour Index, third edition, 73801), so that each higher-numbered reference is approximately twice as fast as the preceding reference.

4.1.3 Humidity test control

Effective humidity is defined as the combination of air and surface temperatures and air relative humidity which governs the moisture content of the surface of the test specimen during exposure. The effective humidity can be measured only by determining the colour fastness of a specific humidity test control.

For the purposes of this part of ISO 105, the humidity test control is a red azoic dyed cotton cloth.

This control has been calibrated by exposing it facing south in several Western European locations at different times of the year, the exposures being made together with the references in sealed vessels containing air maintained at constant humidities between 0 and 100 %; the results did not vary greatly and the mean values are shown in figure 1.

When this control was exposed under the conditions specified in ISO 105-B01 in temperate zones, its colour fastness was found to be, on average, 5.

Table 1 — Dyes for blue wool references 1 to 8

Reference	Dye (Colour Index designation) ¹⁾
1	CI Acid Blue 104
2	CI Acid Blue 109
3	CI Acid Blue 83
4	CI Acid Blue 121
5	CI Acid Blue 47
6	CI Acid Blue 23
7	CI Solubilized Vat Blue 5
8	CI Solubilized Vat Blue 8
¹⁾ The Colour Index (third edition) is published by the Society of Dyers and Colourists, P.O. Box 244, Perkin House, 82 Grattan Road, Bradford BD1 2JB, West Yorks, UK, and by the American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709-2215, USA.	

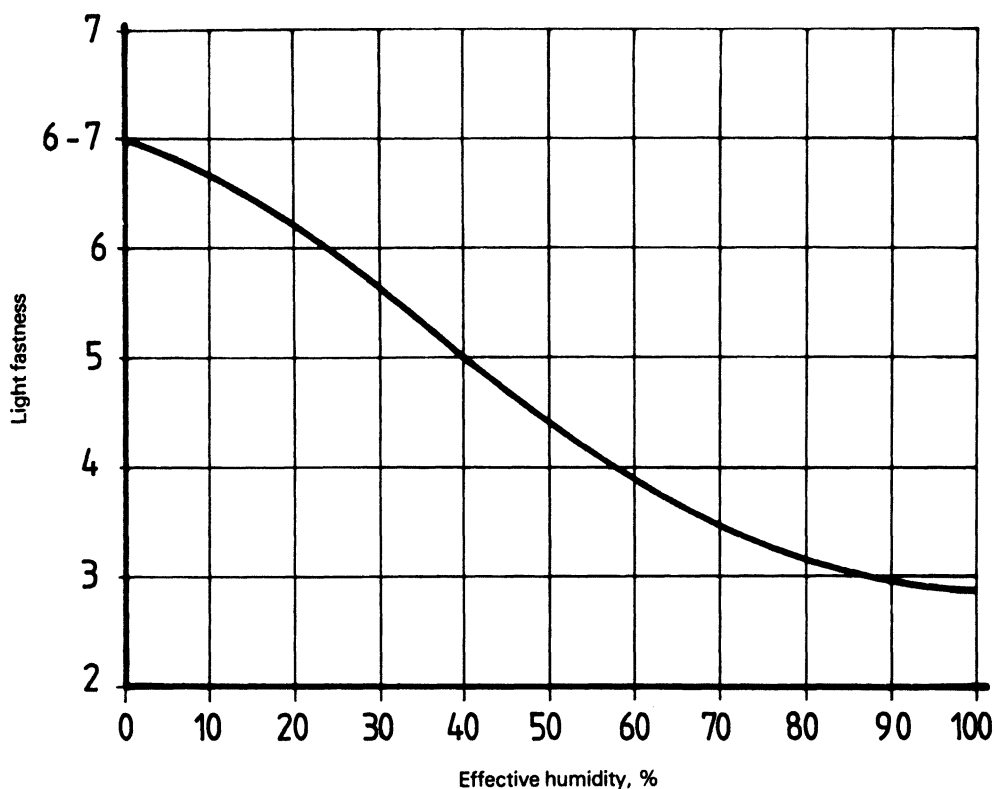


Figure 1 — Mean values obtained from humidity test control exposures

4.2 Apparatus

4.2.1 Xenon arc lamp apparatus, either air-cooled or water-cooled.

The specimens and the references are exposed in one of the two types of apparatus (see 4.2.1.1 and 4.2.1.2). The variation in light intensity over the area covered by the specimens and references shall not exceed $\pm 10\%$ of the mean. The recommended level of irradiance (radiant power per unit area) measured by a radiometer (4.2.6) is $42 \text{ W/m}^2 \times \text{wavelength}$, in nanometres, at 300 nm to 400 nm, equivalent in cases of water-cooled xenon arc apparatus to $1,1 \text{ W/m}^2 \times \text{wavelength}$, in nanometres, at 420 nm.

The distances from the surface of the specimen and from the surfaces of the references to the lamp shall be the same.

4.2.1.1 Air-cooled xenon arc lamp apparatus (see annex A), consisting of the following elements:

NOTE 2 For exposure conditions preferable for use in Europe, see 6.1.

- a) **Light source**, in a well-ventilated exposure chamber.

The light source shall consist of a xenon arc lamp of correlated colour temperature 5 500 K to 6 500 K, the size of which will depend on the type of apparatus used.

- b) **Light filter**, placed between the light source and the specimens and references so that the ultra-violet spectrum is steadily reduced.

The transmission of the filter system used shall be at least 90 % between 380 nm and 750 nm, falling to 0 between 310 nm and 320 nm.

- c) **Heat filter**, placed between the light source and the specimens and references so that the amount of infrared (IR) radiation contained in the xenon arc spectrum is steadily reduced (see A.1.1 and A.2.2).

If a glass or water filter is used to eliminate excess infrared radiation so as to meet the temperature conditions specified in 4.2, frequent cleaning shall be carried out to avoid unwanted filtering caused by dirt (see B.1.4).

ISO 2

4.2.1.2 Water-cooled xenon arc lamp apparatus

(see annex B), consisting of the following elements:

- a) **Light source**, in a well-ventilated exposure chamber.

The light source shall consist of a xenon arc lamp of correlated colour temperature 5 500 K to 6 500 K, the size of which will depend on the type of apparatus used.

- b) **Light filter**, consisting of inner and outer filter glass containing and directing the flow of cooling water, placed between the light source and the specimens and references so that the ultraviolet spectrum and a part of the infrared spectrum are steadily reduced.

For exposure conditions preferable for use in Europe [see 6.1 a) and 6.1 b)]: inner and outer IR filter glass and a lantern, equipped with European window glass. The transmission of the filter system used shall be at least 90 % between 380 nm and 750 nm, falling to 0 between 310 nm and 320 nm.

For exposure conditions preferable for use in America (see 6.2): an inner filter of Pyrex (borosilicate) glass and an outer filter of clear (soda lime) glass are used so that the irradiation at the specimen has a lower spectral cut-off approximately equal to that of window glass (see B.1.2).

- c) **Heat filter**, comprising grade 3 water (see ISO 3696) circulating through the lamp assembly between the inner and outer filter glass, cooled by passing through a heat-exchange unit (see B.1.4).

4.2.2 Opaque cardboard or other thin opaque material, for example thin sheet aluminium or cardboard covered with aluminium foil, for partial covering of samples and references.

4.2.3 Temperature sensor, either a black-panel thermometer (BPT) or black-standard thermometer (BST).

4.2.3.1 The black-panel thermometer (BPT) shall consist of a metal panel at least 45 mm × 100 mm whose temperature is measured with a thermometer or a thermocouple whose sensitive portion is located in the centre of and in good contact with the panel.

The side of the panel facing the light source shall be black with a reflectance of less than 5 % throughout

the spectrum of light reaching the specimen; the side of the panel not facing the light source shall be thermally insulated (see also B.1.5).

4.2.3.2 The black-standard thermometer (BST) shall consist of a plane of stainless steel plate measuring about 70 mm × 30 mm and with a thickness of about 0,5 mm, whose temperature is measured by a thermal resistor, with good heat-conducting properties, fitted to the reverse side. The metal plate is fixed to a plastics plate so that it is thermally insulated. It is coated with a black layer which has an absorption of at least 95 %, even in the infrared range.

4.2.4 Grey scale for assessing change in colour, complying with ISO 105-A02.

4.2.5 Colour-matching lamp, in accordance with CIE Publication No. 51, for assessing change in whiteness.

4.2.6 Radiometer, (when available/specified) for measuring irradiance and radiant exposure in the wavelength range 300 nm to 400 nm or at a specific wavelength (e.g. 420 nm) (see A.1.7 and B.1.8).

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 irradiance (radiant energy flux per unit area) at a point in the plane of the specimen rack.

5 Test specimens

The size of the test specimen will depend on the number of specimens to be tested and on the shape and dimensions of the specimen holders supplied with the apparatus.

5.1 In apparatus of the air-cooled type (4.2.1.1), an area of the textile not less than 45 mm × 10 mm is usually used when 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, yarn 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. Each exposed and unexposed area shall be not less than 10 mm × 8 mm.

5.2 To facilitate handling, the specimen or specimens to be tested and similar strips of the references may be mounted on one or more cards as indicated in figure 2 or 3.

5.3 In apparatus of the water-cooled type, specimen holders are fitted to take specimens of approximately 70 mm × 120 mm. When desired, specimens of different sizes to fit alternative sizes of specimen holder may be used. References shall be exposed on a white cardboard backing. Specimens may also be mounted on white cardboard if desired.

5.4 The covers (4.2.2) shall make close contact with the surface of the unexposed areas of the specimens and the references, in order to give a sharp line of demarcation between exposed and unexposed areas, but shall not compress the specimen unnecessarily.

5.5 The specimens to be tested and the blue wool references shall be of equal size and shape in order to avoid errors in assessment due to overrating the visual contrast between exposed and unexposed parts on a larger pattern as against a narrower reference (see 8.4).

5.6 When testing pile fabrics, the references shall be arranged so that they are the same distance from the light source as the surface of the pile fabrics. This can be achieved for example by using pieces of cardboard as underlay. Covers for the unexposed portions shall avoid surface compression.

Pile fabrics, such as carpets, which have fibres that may shift position or texture which may make evaluation of small areas difficult, shall be tested with an exposed area not less than 50 mm × 40 mm and preferably larger.

6 Exposure conditions

6.1 Conditions preferable for use in Europe

- a) **Normal conditions** (temperate zone): moderate effective humidity (see 4.1.3); colour fastness of the humidity test control: 5; maximum black-standard temperature: 50 °C (see 4.2.3.2).
- b) **Extreme conditions:** For testing the sensitivity of specimens to different humidity during irradiation, the following extreme conditions are useful:

1) low effective humidity:

- colour fastness of the humidity test control: 6-7;
- maximum black-standard temperature: 65 °C;

2) high effective humidity:

- colour fastness of the humidity test control: 3;
- maximum black-standard temperature 45 °C.

NOTE 3 Measurements with the black-panel thermometer (BPT) (4.2.3.1) yield a temperature 5 °C lower than the more modern black-standard thermometer (BST) (4.2.3.2). ISO 1

6.2 Conditions preferable for use in America

Black-panel temperature (63 ± 1) °C (see 4.2.3.1); the controls of the apparatus are adjusted so that the relative humidity of the air in the test chamber is (30 ± 5) %. Effective humidity: low. Colour fastness of the humidity test control: 6-7.

These conditions shall be controlled by continuous operation of a blower, with concomitant measuring and thermostatic control of the temperature of a constant volume of air whose relative humidity is increased by adding moisture to the air as it passes through the conditioning chamber by means of an electrically operated atomizer. ISO 1

7 Procedure

7.1 Adjustment of the humidity (see clause 6)

7.1.1 Check that the apparatus is in good running order and that it is equipped with a clean xenon burner tube. (Follow the manufacturer's directions and see annexes A and B.)

7.1.2 Place a portion of the humidity test control (4.1.3) measuring not less than 45 mm × 10 mm, together with the blue wool references (4.1.1 or 4.1.2), on a card, if possible in the middle area of the specimen holder (see 5.3).

7.1.3 Place the filled specimen holders on the specimen rack of the apparatus, with the holders supported both top and bottom and in proper vertical alignment. Completely fill all remaining spaces in the specimen rack with holders containing white cardboard.

7.1.4 Operate the apparatus with the light on continuously until a test is completed unless the lamp requires cleaning or the burner, outer filter or inner filter requires changing because it has reached the maximum number of hours of recommended usage.

7.1.5 Expose the partially covered strip of the humidity test control and the references simultaneously until a contrast between the exposed and unexposed portions equal to grade 4 on the grey scale is produced on the humidity test control.

7.1.6 Assess the colour fastness of the humidity test control at this stage and, if necessary, adjust the controls on the apparatus to give the selected exposure conditions. Check daily and when necessary readjust the controls to maintain the specified black-panel (black-standard) temperature and humidity.

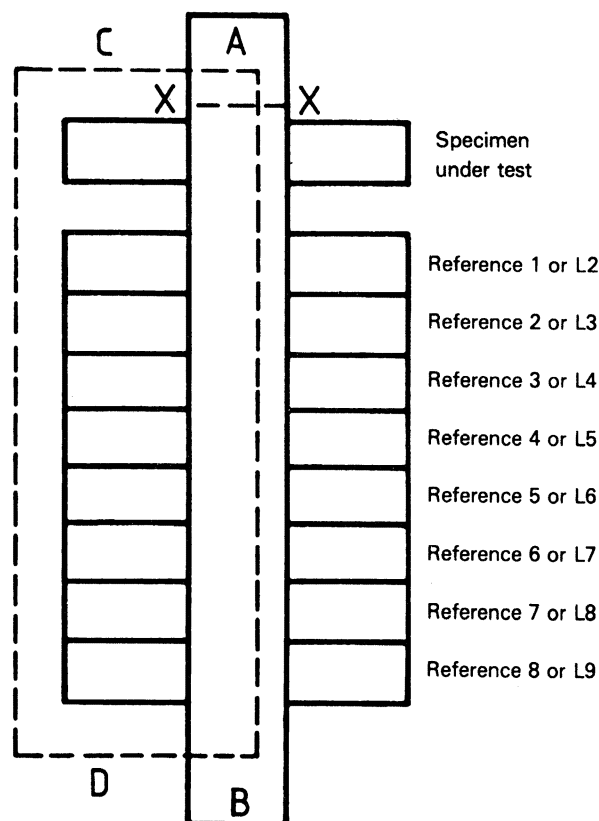
7.2 Exposure methods

Expose the specimen (or group of specimens) and the references simultaneously, under the desired conditions, in such a manner and for such a time as is necessary to evaluate fully the colour fastness of each specimen relative to that of the references, by progressively covering both the specimens and the exposed references during the test (using either method 1 or method 2). Covering arrangements other than those described, for instance covering specimens and references on both ends and exposing the middle third or half, are also allowed.

7.2.1 Method 1

This method is considered most exact and should be used in cases of dispute over the numerical rating. The basic feature is the control of the exposure period by inspection of the *specimen*, and therefore only one set of blue wool references is required for each specimen under test.

7.2.1.1 Arrange the test specimen and the references as shown in figure 2 with an opaque cover AB across the middle one-third of the specimen and references. Expose to the xenon arc light under the conditions enumerated in 7.1. Follow the effect of light by removing the cover and inspecting the specimen frequently. When a change in the test specimen can be perceived equal to grey scale 4-5, note the number of the blue wool reference showing a similar change. (This is a preliminary assessment of colour fastness.)



AB: Opaque cover; may be hinged at X-X so that it can be lifted and returned to the same place over the specimen and references

CD: Second cover

Figure 2 — Mounting of specimen and references for exposure method 1

If there is a possibility of the sample being photochromic, then at this stage the test for photochromism shall be applied additionally (see ISO 105-B05).

For all specimens except for white (bleached or optically brightened) specimens, continue the procedure as described in 7.2.1.2 to 7.2.1.4. For optically brightened textiles, continue with the procedure as described in 7.2.1.5.

7.2.1.2 Continue to expose until the contrast between the exposed and the unexposed portions of the specimen is equal to grey scale grade 4. Cover the left-hand one-third of the specimen and references with an additional opaque cover (CD in figure 2).

7.2.1.3 Continue to expose until the contrast between the fully exposed and unexposed portions of the test specimen is equal to grey scale grade 3.

ISO 1