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Textiles — Tests for colour fastness —

Part B04:
Colour fastness to artificial weathering: Xenon arc fading lamp test

Textiles — Essais de solidité des coloris —

Partie B04: Solidité des coloris aux intempéries artificielles: Lampe à arc au xénon

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC 1, *Tests for coloured textiles and colorants*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 248, *Textiles and textile products,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This fifth edition cancels and replaces the fourth edition (ISO 105-B04:1994), which has been technically revised.

The main changes are as follows:

— the Scope has been refined to differentiate this document from ISO 105-B10;

— the description of the test apparatus has been harmonized with ISO 105-B10. This takes into account current technology, but does not discredit the test procedure described in this document;

— Type I and Type II daylight filters for xenon-arc lamps have been introduced.

A list of all parts in the ISO 105 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

ISO 105 was previously published in thirteen “parts”, each designated by a letter (e.g. “Part A”), with publication dates between 1978 and 1985. Each part contained a series of “sections”, each designated by the respective part letter and by a two-digit serial number (e.g. “Section A01”). These sections are now being republished as separate documents, themselves designated “parts” but retaining their earlier alphanumeric designations.

Textiles — Tests for colour fastness —

Part B04:
Colour fastness to artificial weathering: Xenon arc fading lamp test

1 Scope

This document specifies a method intended for determining the effect on the colour of textiles of all kinds, except loose fibres, to the action of weather as determined by exposure to simulated weathering conditions in a test chamber equipped with a xenon arc lamp. This document focuses on textiles (such as apparel) where the main evaluation criterium is the colour fastness.

This method can be used to determine if a textile is sensitive to the combined effect of light and water.

NOTE 1 General information on colour fastness to light is given in Annex A.

NOTE 2 ISO 105-B10 provides guidance on testing textiles or technical textiles, which are permanently exposed to an outdoor environment and/or require mechanical testing (such as tensile strength determination).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 105-A01, *Textiles — Tests for colour fastness — Part A01: General principles of testing*

ISO 105-A02, *Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour*

ISO 105-A05, *Textiles — Tests for colour fastness — Part A05: Instrumental assessment of change in colour for determination of grey scale rating*

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

ISO 105-B02:2014, *Textiles — Tests for colour fastness — Part B02: Colour fastness to artificial light: Xenon arc fading lamp test*

ISO 105-B08, *Textiles — Tests for colour fastness — Part B08: Quality control of blue wool reference materials 1 to 7*

ISO 4892-1, *Plastics — Methods of exposure to laboratory light sources — Part 1: General guidance*

ISO 9370, *Plastics — Instrumental determination of radiant exposure in weathering tests — General guidance and basic test method*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 105-B02 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Principle

Test specimens of the textile are exposed under specified conditions to light from a xenon arc lamp and to water spray. At the same time, eight dyed blue wool references are exposed to light but are protected from water spray by a sheet of window glass. The fastness is assessed by comparing the change in colour of the test specimen with that of the references.

If the method is used to determine if a textile is sensitive to the combined effect of light and water (see 7.2), the simultaneous exposure of references is unnecessary. In this case, the assessment shall be performed by comparison with the grey scale in accordance with ISO 105-A02 or by colour measurement in accordance with ISO 105-A05.

5 Materials

5.1 Blue wool references

The reference materials used in this test shall be those blue wool references specified in ISO 105-A01 and ISO 105-B01. The blue wool references 1 to 8 used in this test shall meet the quality requirements specified in ISO 105-B08.

5.2 Glass case for blue wool references

The blue wool references shall be protected from water spray by a shield of glass. The transmission of the glass used shall be at least 90 % in the wavelength range from 380 nm and 750 nm, falling to 0 % between 310 nm and 320 nm. The glass case shall be well ventilated, i.e. there shall be an opening at the top and another at the bottom to allow good circulation of air.

5.3 Specimen mounting cards

For mounting the blue wool references, mounting cards from cardboard free of optical or fluorescent brightening agent shall be used.

For exposure cycles with specimen wetting, specimen mounting cards shall be water resistant. Mounting cards shall be made from material resistant to the exposure conditions, such as stainless steel or inert plastic.

5.4 Specimen covers

Specimen covers to partly cover the front of the test specimens shall be made from opaque cardboard, or other thin opaque material, for example stainless steel or thin sheet aluminium. The cover material shall be inert to the test conditions and not react with the test specimen.

If specimen covers are used for the test specimen, these shall be water resistant.

5.5 Specimen holders

Specimen holders shall be used to hold the test specimen on the specimen mounting card and the specimen covers, if used, during the exposure. Specimen holders shall be made of inert materials that will not affect the test results. They are preferably made in the form of an open frame. If required, a metal plate can be used to close the specimen holders from the rear.

5.6 Grey scale for assessing change in colour

Grey scale for assessing change in colour shall be in accordance with ISO 105-A02.

6 Apparatus

6.1 Laboratory light source

6.1.1 General

The light source shall be one or more quartz-jacketed xenon-arc lamps, which emit radiation from about 270 nm in the ultraviolet through the visible spectrum and into the infrared. In order to simulate global solar radiation at the earth's surface as described in CIE 241[1], CIE-H1, so-called daylight filters shall be used to remove short wavelength UV radiation shorter than 290 nm. In addition, filters to remove infrared radiation may be used to prevent unrealistic heating of test specimens that can cause thermal degradation not experienced during outdoor exposures.

Solar spectral irradiance for a number of different atmospheric conditions is described in CIE 241. Like other International Standards, this document uses CIE 241 as a benchmark for solar spectral irradiance.

The xenon-arc light source may be either air-cooled or water-cooled. The size, form and number of xenon-arc lamps depend on the type of apparatus. When available, an irradiance-controlled light source should be used.

The variation in irradiance over the area covered by the test specimens shall not exceed ±10 % of the mean. If this cannot be achieved, test specimens shall be periodically repositioned to provide equivalent exposure periods in each location. Periodic repositioning of the test specimens in the test chamber is recommended to ensure the most consistent results.

The characteristics of xenon-arc lamps and filters are subject to change during use due to ageing, and lamps and filters shall be replaced at suitable intervals. Furthermore, they are subject to change due to the accumulation of dirt and shall therefore be cleaned at suitable intervals. Follow the manufacturer's recommendations for replacement and cleaning of lamps and filters.

6.1.2 Spectral irradiance

Optical filters are used to reduce the xenon-arc emission in order to simulate daylight (CIE 241, CIE-H1[1]). The minimum and maximum levels for the relative spectral irradiance in the UV wavelength range of radiation are given in Table 1.

Table 1 allows a range of different spectral irradiance distributions in the UV, referred to as general daylight. Depending on the spectral irradiance distribution within the specifications of Table 1, the test results can vary. It is recommended to agree on selection of the filter system according to the Type I or the Type II specification in Table 1 between the interested parties. Background information on the different types of daylight filters can be found in ISO 4892-2[2] and ISO 4892-2:2013/Amd 1:2021, Annex C[3].

Table 1 — Relative spectral irradiance of xenon-arc lamps with daylight filters[a]

Spectral bandpass (λ = wavelength in nm)	General[b]		Type I[f]		Type II[g]		CIE 241, CIE-H1[d,e] %
	Min[c] %	Max[c] %	Min[c] %	Max[c] %	Min[c] %	Max[c] %	
λ < 300	2,60	8,05	0,00	0,20	0,20	1,05	5,86
300 ≤ λ ≤ 320			2,60	6,00	3,50	7,00	
320 < λ ≤ 340	28,2	39,8	10,0	17,0	10,0	17,0	40,4
340 < λ ≤ 360			18,3	23,2	18,3	23,2	
360 < λ ≤ 380	54,2	67,5	25,0	30,5	25,0	30,5	53,8
380 < λ ≤ 400			29,2	37,0	29,2	37,0	

[a] This table gives the irradiance in the given passband, expressed as a percentage of the total irradiance from 290 nm to 400 nm. To determine whether a specific filter or set of filters for a xenon-arc lamp meets the requirements of this table, the spectral irradiance shall be measured from 250 nm to 400 nm. The total irradiance in each wavelength passband is then summed and divided by the total irradiance from 290 nm to 400 nm. There shall be no irradiance below 290 nm.

[b] The minimum and maximum data in this table are based on more than 100 spectral irradiance measurements for water-cooled and air-cooled xenon-arc instruments with daylight filters from different production lots and various ages (see ISO 4892-2), in accordance with the recommendations of the manufacturer. The minimum and maximum data are at least three sigma limits from the mean of all measurements.

[c] The minimum and maximum columns will not necessarily sum to 100 % because they represent the minimum and maximum for the data used. For any individual spectral irradiance, the calculated percentage for the bandpasses in this table will sum to 100 %. For any individual xenon-arc lamp with daylight filters, the calculated percentage in each bandpass shall fall within the minimum and maximum limits given. Test results can be expected to differ if obtained using xenon-arc devices in which the spectral irradiances differed by as much as that allowed by the tolerances. Contact the manufacturer of the xenon-arc device for specific spectral irradiance data for the xenon-arc and filters used.

[d] The data from CIE 241, CIE-H1 represent global solar spectral irradiance on a horizontal surface with an air mass of 1,0, column ozone of 0,34 cm at standard temperature and pressure (STP), 1,42 cm precipitable water vapour, and spectral optical depth of aerosol extinction of 0,1 at 500 nm. These data serve as target values for xenon-arc lamps with daylight filters.

[e] For the solar spectrum represented by CIE 241, CIE-H1, the UV irradiance (290 nm to 400 nm) is 10,5 % and the visible irradiance (400 nm to 800 nm) is 89,5 %, expressed as a percentage of the total irradiance from 290 nm to 800 nm. These percentages of UV irradiance and visible irradiance on test specimen exposed in xenon-arc devices may vary due to the number and reflectance properties of specimens being exposed.

[f] Daylight filter systems as described in ASTM D7869[4] fall under the definition of Type I Daylight filters.

[g] Daylight filter spectral requirements as described in SAE J2527[5] have been historically achieved using Type II Daylight filters.

6.2 Test chamber

The design of the test chamber may vary, but it shall be constructed from inert material. The test chamber shall provide means for measurement and control of irradiance, black standard or black panel temperature (as described in 6.4.3), chamber air temperature and relative humidity. It shall also provide a system to provide humidification, a device for wetting the surface of the test specimens and a frame to carry specimen holders.

Relative humidity sensors have to be shielded from direct radiation. They can either be electronic humidity sensors, or of the “wet bulb” type, where the humidity is defined by the difference in the air temperature within the test chamber. The location of sensors used to measure humidity shall be according to ISO 4892-1.

The water used for humidification and for wetting the specimen shall comply with the requirements in ISO 4892-1. Unless otherwise specified, water used for specimen spray shall contain a maximum of 1 µg/g of solids and a maximum of 0,2 µg/g of silica. For spraying the test specimens, only completely ion-free water shall be used. Tubing, tanks, and spray jets shall be of corrosion-resistant material.

If equipment is used with irradiance control by adjusting lamp power manually, this shall be noted in the test report.