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Textiles - Tests for colour fastness - Artificial weathering - Exposure to filtered xenon-arc radiation

(ISO 105-B10:2011, MOD)

纺织品 色牢度试验 人造气候老化 暴露于过滤氙弧辐射

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1 Scope

This Standard specifies a procedure for exposing textiles to artificial weathering in filtered xenon-arc apparatus (including the action of liquid water and water vapour) in order to determine the weather resistance of the colour of textiles. The filtered xenon-arc light source in the test chamber simulates the solar spectral irradiance specified in Table 4 of CIE 85:1989.

This Standard applies to the testing of textiles for either their weather fastness or aging resistance; it also applies to white (bleached or optically brightened) textiles.

2 Normative references

The following referenced documents are indispensable for the application 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.

GB/T 250, Textiles - Tests for colour fastness - Grey scale for assessing change in colour (GB/T 250-2008, ISO 105-A02:1993, IDT)

GB/T 6151-2016, Textiles - Tests for colour fastness - General principle of testing (ISO 105-A01:2010, MOD)

GB/T 6529, Textiles - Standard atmospheres for conditioning and testing (GB/T 6529-2008, ISO 139:2005, MOD)

GB/T 16422.1, Plastics - Methods of exposure to laboratory light sources - Part 1: General guidance (GB/T 16422.1-2006, ISO 4892-1:1999, IDT)

GB/T 32616, Textiles - Tests for colour fastness - instrumental assessment of change in color for determination of grey scale rating (GB/T 32616-2016, ISO 105-A05:1996, MOD)

CIE 15, Colorimetry (Third edition)

CIE 51.2, A method for assessing the quality of daylight simulators for colorimetry

CIE 85:1989, Solar spectral irradiance

be comparable. Both two types of thermometers shall meet the requirements of GB/T 16422.1. Generally, BST and BPT do not give the same readings.

In weathering devices where specimens are positioned in a flat plane in front of a light source, a black-standard thermometer shall be used.

Note 1: The BST differs from the BPT because the black plate of the BST is fixed on a thermally insulated mounting. The temperatures measured therefore correspond approximately to those measured on the exposed surface of the test specimen with a black or dark-coloured coating on a substrate of low thermal conductivity. The surface temperatures of light-coloured test panels will usually be lower.

Note 2: The surface temperature of a test specimen depends on a number of factors, including the amount of radiation absorbed, the amount of radiation emitted, thermal-conduction effects with the test specimen and heat transfer between the test specimen and the air, and between the test specimen and the specimen holder, and cannot therefore be predicted with accuracy.

Note 3: In a typical exposure environment (no high irradiance), the BST temperature is usually about 2 °C ~ 5 °C higher than the BPT temperature.

Note 4: The black-standard thermometer is also called insulated black-panel thermometer. The black-panel thermometer is also called uninsulated black-panel thermometer.

5.4.2.1 Black-standard thermometer (BST)

The black-standard thermometer for measuring the black-standard temperature in the plane of the test specimens during the dry period shall consist of a plane stainless-steel plate with a thickness of about 0.5 mm ~ 1.0 mm. The typical length and width is about 70 mm × 40 mm; the surface of the plate facing the light source shall be coated with a black layer that has good resistance to ageing. The coated plate shall absorb at least 90% of all incident flux up to 2 500 nm. A platinum resistance sensor shall be attached in good thermal contact to the centre of the plate on the side opposite the radiation source. The side of the stainless-steel panel on the side opposite the radiation source shall be attached to a 5 mm thick base-plate, which is made of unfilled polyvinylidene difluoride (PVDF). There is a small recess that is sufficient to hold the platinum resistance sensor in the PVDF base-plate. The distance between the recess in the PVDF base-plate and the sensor shall be about 1 mm. The length and the width of the PVDF plate shall be sufficiently large to ensure that no metal-to-metal thermal contact exists between the black-coated metal plate of the black-standard thermometer and the mounting holder into which it is fitted. The metal mounts of the holder of the insulated black panel shall be at least 4 mm from the edges of the metal plate. As long as the exposure equipment can reach the set stable temperature and irradiance conditions, and the indicated temperature of the selected thermometer of other structures is within ±1°C of the

not contaminate the water employed. In case of immersion, the BST or BPT sensor shall also be completely immersed.

The conductivity of the spray water shall be less than 5 μS/cm; the insoluble content shall be less than 1 μg/g; no visible stains or deposits shall be left on the surface of the specimens. The silicon content shall be kept below 0.2 μg/g. A combination of deionization and reverse osmosis can be used to produce water of the desired quality.

Note: Wetting of the samples by water spray or by immersion does not necessarily lead to similar results.

5.6 Specimen holders

Specimen holders shall be made of inert materials that will not affect the test results. The specimen holders are preferably made in the form of an open frame. If required, a metal plate can be used to close the specimen holder from the rear.

Additional devices may be used to mount different types of specimens. An open inner metal frame, which can take up thin textile specimens sewn to a ring, can be used inside the main frame. Otherwise, inert materials, such as metal or specifically neutral plastic sheets, can be used to mount specimens. White cardboard without an optical brightener can be used when applying exposure conditions without water spray.

Opaque covers, made from inert materials (such as thin sheets of aluminum or plastic) may be used to partly cover a portion of the specimens. White cardboard without an optical brightener can be used when applying exposure conditions without water spray.

Places not used for specimens shall be filled with dummy specimens, such as neutral plastic plates or stainless-steel plates, in order to obtain uniform exposure conditions.

Details on specimen holders and mounting of the specimens shall be included in the test report.

5.7 Spectrophotometer

The spectrophotometer for colorimetric measurement of colour difference shall comply with GB/T 32616.

5.8 Colour-matching lamp

The colour-matching lamp for assessing change in whiteness shall be in accordance with CIE 15 or CIE 51.2.

5.9 Grey scale for assessing change in colour

The grey scale shall be in accordance with GB/T 250.

5.10 Reference materials

It is recommended to use appropriate reference materials (see 3.1) to check the exposure apparatus and operating conditions by monitoring the know function of the reference material in change of colour (or a different suitable property) depending on the radiant exposure.

For sets of exposure conditions A and C, the use of Blue Wool References 1 ~ 8 or L2 ~ L9 is not recommended, because they are not designed for exposure to wetting.

Note 1: In plastic and polymer coating industries, thin aluminum sheets coated with orange paint can be used to check the exposure apparatus. This reference material is mainly sensitive to irradiance, and to water spray intensity, if applicable. Nevertheless, there are no data available yet on the use of this material for application.

Note 2: The function of the change in colour or a different suitable property depending on the radiant exposure or test duration, under specified exposure conditions, can be provided by the manufacturers of reference materials.

5.11 Metal or clear plastic sheet (PMA)

Sheets made of solid inert material (metal or clear plastic), on which to mount the textile specimens (see 6.1.3).

6 Test specimens

6.1 For artificial weathering with water spray

6.1.1 If multiple specimens are placed on the same specimen holder in the vertical direction, the dye washed out from the upper specimens may stain the lower specimens. The stained specimens shall be discarded and exposure shall be repeated.

6.1.2 Open loop method: A piece of textile is cut into approximately 40 mm × 100 mm, sewn into a ring, and firmly embedded in a 40 mm wide frame made from a metal wire of approximately 4 mm in diameter. If an open specimen holder is used, the rear of the specimen should be closed with a metal plate to expose the entire front of the specimen.

6.1.3 Alternatively, place a specimen not less than 30 mm × 45 mm on the backing plate of the inert material (5.11). Exposing the whole surface without covering is preferred, but if required, a thin aluminum plate or an opaque plastic plate can be used to cover part of the specimen. The covers should be in close contact to the specimens, in order to mark sharp lines between exposed and covered areas. The covers can be applied as usual from left to right. However, if bigger specimens (e.g., 100 mm × 45 mm) are available or more than one step exposure is required, using covers of increasing sizes from step to step, covering from top down is recommended, in order to minimize water retention inside the specimen holders.

(CIELab) value is compared with the known value of the reference material. If the value does not lie within the specified tolerances, the exposure apparatus has to be readjusted. Reasons for deviations can be:

-- differences in irradiance adjustment or measurement by the test apparatus;

-- differences in temperature;

-- differences in the position of the reference specimen within the test apparatus;

-- exposure apparatus not properly calibrated.

8.2 Mounting of the test specimens

Fix the specimen in the appropriate specimen holder; if necessary, cover part of the specimen surface. Covering arrangements depend on the agreement of the parties involved, the type of exposure conditions, and the preparation of test specimens as specified in Chapter 6. Identify the specimens by suitable indelible markings.

In order to obtain consistent results in long-term exposure, the position of each specimen can be changed periodically. However, this is not recommended for a short time exposure.

8.3 Exposure

8.3.1 Exposure for a fixed duration or radiant exposure

Expose the specimen or a group of specimens to specified exposure conditions for the desired duration or radiant exposure. If applicable, change covers according to the positioning and timing protocol that has been agreed on by the parties involved. After exposure, remove the specimens from the specimen holders, and store them in the dark under normal ambient conditions under the standard conditions specified in GB/T 6529 for at least 5 h to allow acclimatization and relaxation.

8.3.2 Exposure to a control material

Expose the specimen or a group of specimens simultaneously, together with the control specimen, under the specified exposure conditions. Regularly check the specimens in comparison to the control specimens, until the color difference between the exposed part of the control specimen and the original control specimen (weathering with wetting) or the covered part of the control specimen (weathering without wetting) can be clearly identified. Stepwise exposure, by covering parts of the exposed specimens and the control specimen, can be applied.

Note: In general, when the colour change reaches level 4 of the grey scale rating, it is considered that the color difference can be clearly identified.

After exposure, remove the specimens from the specimen holders, and store them in the dark under normal ambient conditions under the standard conditions specified in GB/T 6529 f or at least 5 h to allow acclimatization and relaxation.

9 Assessment

9.1 Colour change

Assess the relevant colour changes under the illumination specified in Chapter 15 of GB/T 6151-2016.

For tests with water spray (conditions A and C), the exposed portion of the specimen is assessed against the original specimen.

For tests without water spray (conditions B and D), the exposed portion of the specimen is assessed against the covered part of the specimen.

The assessment is done either by using the grey scale for colour change according to GB/T 250, or by using spectrophotometric measurements, followed by calculation of corresponding grey scale ratings according to GB/T 32616. Ratings are in the range of 5 (no visible colour change) ~ 1 (very strong colour change).

Results may also be obtained by measuring the color change value ΔE* (CIELab) or other colorimetric systems, if agreed upon between interested parties.

It is also possible to compare the colour change of the specimen with the control specimen agreed by the relevant parties according to the exposure method specified in 8.3.2. If the specimen under test has the same or lower colour difference than the control specimen, the test result will be given as “satisfactory”. If the specimen under test has a higher colour difference than the control specimen, the test result will be given as “unsatisfactory”.

9.2 Ageing behavior

Assess the change in the selected property (ageing criterion) in accordance with the appropriate test standard.

10 Test report

The test report shall include the following contents:

a) a reference to this Standard.

b) specimen description.

c) type of the exposure apparatus.

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