INTERNATIONAL STANDARD

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Textiles — Tests for colour fastness —

Part A01: General principles of testing

Textiles — Essais de solidité des coloris —

Partie A01: Principes généraux pour effectuer les essais

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Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 105-A01 was prepared by Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC 1, *Tests for coloured textiles and colorants*.

This sixth edition cancels and replaces the fifth edition (ISO 105-A01:1994), which has been revised to list the current ISO 105 standards, Clause 2 has been editorially revised, and other editorial revisions have been made to update the fifth edition.

ISO 105 consists of the following parts, under the general title *Textiles — Tests for colour fastness*:

General principles:

— *Part A01: General principles of testing*

— *Part A02: Grey scale for assessing change in colour*

— *Part A03: Grey scale for assessing staining*

— *Part A04: Method for the instrumental assessment of the degree of staining of adjacent fabrics*

— *Part A05: Instrumental assessment of change in colour for determination of grey scale rating*

— *Part A06: Instrumental determination of 1/1 standard depth of colour*

— *Part A08: Vocabulary used in colour measurement*

— *Part A11: Determination of colour fastness grades by digital imaging techniques* (under development)

Colour fastness to light and weathering:

— *Part B01: Colour fastness to light: Daylight*

— *Part B02: Colour fastness to artificial light: Xenon arc fading lamp test*

— *Part B03: Colour fastness to weathering: Outdoor exposure*

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

— *Part B05: Detection and assessment of photochromism*

— *Part B06: Colour fastness and ageing to artificial light at high temperatures: Xenon arc fading lamp test*

— *Part B07: Colour fastness to light of textiles wetted with artificial perspiration*

— *Part B08: Quality control of blue wool reference materials 1 to 7*

— *Part B10: Artificial weathering — Exposure to filtered xenon-arc radiation* (under development)

Colour fastness to washing and laundering:

— *Part C06: Colour fastness to domestic and commercial laundering*

— *Part C07: Colour fastness to wet scrubbing of pigment printed textiles*

— *Part C08: Colour fastness to domestic and commercial laundering using a non-phosphate reference detergent incorporating a low temperature bleach activator*

— *Part C09: Colour fastness to domestic and commercial laundering — Oxidative bleach response using a non-phosphate reference detergent incorporating a low temperature bleach activator*

— *Part C10: Colour fastness to washing with soap or soap and soda*

— *Part C12: Colour fastness to industrial laundering*

Colour fastness to dry cleaning:

— *Part D01: Colour fastness to dry cleaning using perchloroethylene solvent*

— *Part D02: Colour fastness to rubbing: Organic solvents*

Colour fastness to aqueous agents:

— *Part E01: Colour fastness to water*

— *Part E02: Colour fastness to sea water*

— *Part E03: Colour fastness to chlorinated water (swimming-pool water)*

— *Part E04: Colour fastness to perspiration*

— *Part E05: Colour fastness to spotting: Acid*

— *Part E06: Colour fastness to spotting: Alkali*

— *Part E07: Colour fastness to spotting: Water*

— *Part E08: Colour fastness to hot water*

— *Part E09: Colour fastness to potting*

— *Part E10: Colour fastness to decatizing*

— *Part E11: Colour fastness to steaming*

— *Part E12: Colour fastness to milling: Alkaline milling*

— *Part E13: Colour fastness to acid-felting: Severe*

— *Part E14: Colour fastness to acid-felting: Mild*

— *Part E16: Colour fastness to water spotting on upholstery fabrics*

Standard adjacent fabrics:

— *Part F01: Specification for wool adjacent fabric*

— *Part F02: Specification for cotton and viscose adjacent fabrics*

— *Part F03: Specification for polyamide adjacent fabric*

— *Part F04: Specification for polyester adjacent fabric*

— *Part F05: Specification for acrylic adjacent fabric*

— *Part F06: Specification for silk adjacent fabric*

— *Part F07: Specification for secondary acetate adjacent fabric*

— *Part F09: Specification for cotton rubbing cloth*

— *Part F10: Specification for adjacent fabric: Multifibre*

Colour fastness to atmospheric contaminants:

— *Part G01: Colour fastness to nitrogen oxides*

— *Part G02: Colour fastness to burnt-gas fumes*

— *Part G03: Colour fastness to ozone in the atmosphere*

— *Part G04: Colour fastness to oxides of nitrogen in the atmosphere at high humidities*

Measurement of colour and colour differences:

— *Part J01: General principles for measurement of surface colour*

— *Part J02: Instrumental assessment of relative whiteness*

— *Part J03: Calculation of colour differences*

— *Part J05: Method for the instrumental assessment of the colour inconstancy of a specimen with change in illuminant (CMCCON02)*

Colour fastness to bleaching agencies:

— *Part N01: Colour fastness to bleaching: Hypochlorite*

— *Part N02: Colour fastness to bleaching: Peroxide*

— *Part N03: Colour fastness to bleaching: Sodium chlorite (mild)*

— *Part N04: Colour fastness to bleaching: Sodium chlorite (severe)*

— *Part N05: Colour fastness to stoving*

Colour fastness to heat treatments:

— *Part P01: Colour fastness to dry heat (excluding pressing)*

— *Part P02: Colour fastness to pleating: Steam pleating*

Colour fastness to vulcanization:

— *Part S01: Colour fastness to vulcanization: Hot air*

— *Part S02: Colour fastness to vulcanization: Sulfur monochloride*

— *Part S03: Colour fastness to vulcanization: Open steam*

Miscellaneous tests:

— *Part X01: Colour fastness to carbonizing: Aluminium chloride*

— *Part X02: Colour fastness to carbonizing: Sulfuric acid*

— *Part X04: Colour fastness to mercerizing*

— *Part X05: Colour fastness to organic solvents*

— *Part X06: Colour fastness to soda boiling*

— *Part X07: Colour fastness to cross-dyeing: Wool*

— *Part X08: Colour fastness to degumming*

— *Part X09: Colour fastness to formaldehyde*

— *Part X10: Assessment of migration of textile colours into polyvinyl chloride coatings*

— *Part X11: Colour fastness to hot pressing*

— *Part X12: Colour fastness to rubbing*

— *Part X13: Colour fastness of wool dyes to processes using chemical means for creasing, pleating and setting*

— *Part X14: Colour fastness to acid chlorination of wool: Sodium dichloroisocyanurate*

— *Part X16: Colour fastness to rubbing—Small areas*

— *Part X18: Assessment of the potential to phenolic yellowing of materials*

Colorant characteristics:

— *Part Z01: Colour fastness to metals in the dye-bath: Chromium salts*

— *Part Z02: Colour fastness to metals in the dye-bath: Iron and copper*

— *Part Z03: Intercompatibility of basic dyes for acrylic fibres*

— *Part Z04: Dispersibility of disperse dyes*

— *Part Z05: Determination of the dusting behaviour of dyes*

— *Part Z06: Evaluation of dye and pigment migration*

— *Part Z07: Determination of application solubility and solution stability of water-soluble dyes*

— *Part Z08: Determination of solubility and solution stability of reactive dyes in the presence of electrolytes*

— *Part Z09: Determination of cold water solubility of water-soluble dyes*

— *Part Z10: Determination of relative colour strength of dyes in solution*

— *Part Z11: Evaluation of speckiness of colorant dispersions*

Textiles — Tests for colour fastness —

Part A01:
General principles of testing

1 Scope

This part of ISO 105 provides general information about the methods for testing colour fastness of textiles for the guidance of users. The uses and limitations of the methods are pointed out, several terms are defined, an outline of the form of the methods is given and the contents of the clauses constituting the methods are discussed. Procedures common to a number of the methods are discussed briefly.

Colour fastness means the resistance of the colour of textiles to the different agents to which these materials may be exposed during manufacture and their subsequent use. The change in colour and staining of undyed adjacent fabrics are assessed as fastness ratings. Other visible changes in the textile material under test, for example surface effects, change in gloss or shrinkage, are considered as separate properties and reported as such.

The methods can be used not only for assessing colour fastness of textiles but also for assessing colour fastness of dyes. When a method is so used, the dye is applied to the textile in specified depths of colour by stated procedures and the material is then tested in the usual way.

For the most part, individual methods are concerned with colour fastness to a single agent, as the agents of interest in a particular case, and the order of application, will generally vary. It is recognized that experience and future developments in practice can justify procedures in which two or more agents are combined.

The conditions in the tests have been chosen to correspond closely to treatments usually employed in manufacture and to conditions of ordinary use. At the same time, they have been kept as simple and reproducible as possible. As it cannot be hoped that the tests will duplicate all the conditions under which textiles are processed or used, the fastness ratings are interpreted according to the particular needs of each user. They provide, however, a common basis for testing and reporting colour fastness.

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.

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

ISO 105-A03, *Textiles — Tests for colour fastness — Part A03: Grey scale for assessing staining*

ISO 105-A04, *Textiles — Tests for colour fastness — Part A04: Method for the instrumental assessment of the degree of staining of adjacent fabrics*

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

ISO 139, *Textiles — Standard atmospheres for conditioning and testing*

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

CIE[1)] Publication 51, *A method for assessing the quality of daylight simulators for colorimetry*

3 General principle

A specimen of the textile to be tested, with adjacent fabric attached if staining is to be assessed, is subjected to the action of the agent in question. The extent of any change in colour and that of any staining of the adjacent fabric are assessed and expressed in fastness numbers.

4 Outline of form of the methods

The headings of the principal clauses of the individual test methods are as follows:

“Introduction”

“Scope”

“Normative references”

“Terms and definitions”

“Principle”

“Apparatus”, “Reagents” or “Reference materials”

“Test specimen”

“Procedure”

“Test report”

5 The “Scope” clause

Under this heading, in each method, are given the intended use of the method and the aspects covered, thereby indicating the limits of applicability.

Details of the principal natural and man-made fibres which can be submitted to each test are given. These lists are by no means exclusive, and any dyed or printed material not mentioned in the method (whether manufactured wholly from one fibre or from a mixture of fibres) can be submitted to the test. In such cases, it is necessary to verify and note whether the procedure is likely to cause any alteration in the material under test. This applies particularly to all man-made fibres (acrylic, pure or copolymer; polyvinyl, pure or copolymer; polyester, etc.) currently being developed, of which any list is always likely to be incomplete.

6 The “Normative references” clause

Under this heading, in each method, is given a complete list of other documents which are indispensable for the application of the method.

1) Commission internationale de l'éclairage, Central Bureau, Kegelgasse 27, A-1030, Vienna, Austria.

7 The “Terms and definitions” clause

Under this heading are definitions of any terms that may not be clear.

8 The “Principle” clause

Under this heading, in each method, is given a concise statement of the principle of the method to enable the user to decide whether the method is the one that they are seeking.

9 The “Apparatus”, “Reagents” or “Reference materials” clause(s)

9.1 General

Under these headings, either individually or combined, in each method, the equipment and supplies required for the test are described.

NOTE For information on the sources of apparatus and reference materials for use in the various parts of ISO 105, write to the following addresses by email or post, enclosing a stamped addressed envelope for reply:

British Standards Institution
389 Chiswick High Road
London W4 4AL
United Kingdom
Email: info@bsi.org.uk
Website: www.bsi-global.com

and

AATCC
1 Davis Drive
PO Box 12215
Research Triangle Park
North Carolina 27709 2215
USA
Email: info@aatcc.org
Website: www.aatcc.org

9.2 Test solutions

9.2.1 Test solutions shall be prepared using Grade 3 water complying with ISO 3696.

9.2.2 The concentrations of baths are given in millilitres per litre (ml/l) or grams per litre (g/l).

9.2.3 The qualities of chemicals to be used are given in each method.

9.2.4 For crystalline substances, the amount of water of crystallization is given and, for liquids, the relative density at 20 °C.

9.3 Adjacent fabrics

An adjacent fabric is a small piece of undyed cloth, of a single or of several generic kinds of fibres, to be used during the test for assessing staining.

9.3.1 Single-fibre adjacent fabrics, if not otherwise specified, should be of plain weave, medium mass per unit area and free from chemically damaged fibres, finished residual chemicals, dyes or fluorescent whitening agents.

9.3.2 Properties of the single-fibre adjacent fabrics are given under the different adjacent fabric specifications.

9.3.3 Multifibre adjacent fabrics are made of yarns of various generic kinds of fibres, each of which forms a strip of at least 1,5 cm width providing even thickness of the fabric. It is intended that the staining properties of generic fibres used in single fibre and multifibre adjacent fabrics be identical. The staining properties of these fabrics should be verified by the supplier. There are two standardized multifibre adjacent fabrics, whose contents differ:

a) Type DW (Diacetate-Wool): secondary acetate, bleached cotton, polyamide, polyester, acrylic, wool (see ISO 105-F10);

b) Type TV (Triacetate-Viscose): triacetate, bleached cotton, polyamide, polyester, acrylic, viscose (see ISO 105-F10).

9.4 Standard of fading

A standard of fading is a dyed fabric of appearance similar to the test control (see 10.1.4), showing the colour to which the test control should fade during the test.

9.5 Selection and use of adjacent fabrics

9.5.1 General

Two alternative procedures for selection of adjacent fabrics are provided, and details of the type of adjacent fabrics used shall be given in the test report (see Clause 16), including dimensions, since there may be differences in test results when multifibre adjacent fabrics are used instead of single-fibre adjacent fabrics.

9.5.2 Types of adjacent fabric

Either of the following procedures may be used.

a) Two single-fibre adjacent fabrics. The first adjacent fabric shall be of the same generic kind of fibre as the material under test or that predominating in the case of blends. The second adjacent fabric shall be that indicated in the individual test or as otherwise specified.

b) One multifibre adjacent fabric. In this case, no other adjacent fabric may be present, as this can affect the degree of staining of the multifibre fabric.

9.5.3 Dimensions and use of adjacent fabrics

9.5.3.1 When single-fibre adjacent fabrics are used, these shall be of the same dimensions as the specimen under test (normally 40 mm $\times$ 100 mm). As a general principle, each surface of the specimen is completely covered by each of the adjacent fabrics. Special requirements are outlined in 10.3.

9.5.3.2 When a multifibre adjacent fabric is used, this shall be of the same dimensions as the specimen under test (normally 40 mm $\times$ 100 mm). As a general principle, it shall cover the face side only of the specimen. Special requirements are given in 10.3.

10 The “Test specimen” clause

10.1 General

10.1.1 Under this heading, in each method, are given the particular requirements for the specimen to be used in the test.

Definitions of the following terms are given below:

— “specimen”;

— “composite specimen”;

— “test-control specimen”.

General directions for their preparation are also given in 10.1.2 to 10.1.4.

10.1.2 A specimen is a small piece of textile material that is to be submitted to the test; it is usually taken from a larger sample representing a lot of the dyed or printed textile material.

10.1.3 A composite specimen is the specimen together with one or two selected adjacent fabrics used for assessing staining.

10.1.4 A test-control specimen is a specimen of known extent of colour change and/or staining during the test, used to ensure that the test is conducted correctly. Details of the preparation of the test-control specimens are given, as appropriate, in each individual test method. The test-control specimen is treated in parallel with the test specimen under the same conditions, as prescribed in the individual test method.

10.2 Preparation of specimens

10.2.1 Fabrics

Specimens of specified dimensions are cut from woven and knitted fabrics, felts and other piece goods. The fabrics shall be free from creases, so that the treatment they receive may result in uniform action over the whole area.

10.2.2 Yarns

Yarns to be tested may be knitted into fabric, from which a specimen is taken. They may also be wound parallel, for example on a U-shaped wire frame. For dry treatments, close winding on a card is recommended. For certain wet treatments without accompanying undyed adjacent material, hanks of yarn tied at both ends may be used.

The method of preparation used shall be specified in the test report (see Clause 16).

10.2.3 Loose fibres

Loose fibres may be tested after combing and compressing into a sheet.

10.2.4 Oiled woollen materials

For oiled woollen materials where the oil may be contaminated with a dyestuff, the samples shall be scoured so that they are clean, having an oil content of less than 0,5 % prior to fastness testing, using the following method.

Hand-scour the sample in a solution containing 5 g/l nonionic detergent using a liquor ratio of 50:1 at a temperature between 40 °C and 45 °C for 1 min. Rinse thoroughly using Grade 3 water at a temperature

between 40 °C and 45 °C. If colour is still visible in the liquor at the end of the rinsing cycle , repeat the rinsing procedure until the final rinse liquor is completely clear.

10.3 Preparation of composite specimens

10.3.1 Sewing threads shall be free from fluorescent brightening agents.

10.3.2 Composite specimens using two single-fibre adjacents.

10.3.2.1 If the specimen is a fabric, it is normally placed between the two adjacent fabrics and sewn along one short side, although for certain methods it is sewn along all four sides.

10.3.2.2 When testing unions in which one fibre predominates on one side and another fibre on the other side, the specimen shall be placed between the adjacent fabrics, so that the predominant fibre is next to the adjacent fabric of the same generic kind of fibre.

10.3.2.3 If the specimen is a printed fabric, the composite specimen is arranged in such a manner that the face is in contact with half of each of the two adjacent fabrics; depending on the design of the print, more than one composite specimen may be required.

10.3.2.4 If the specimen is yarn or loose fibre, an amount approximately equal to one-half of that of the combined mass of the adjacent fabrics is evenly spread over one adjacent fabric, covered with the other, and sewn around all four sides.

10.3.3 Composite specimens using one multifibre adjacent.

10.3.3.1 If the specimen is fabric, it is placed with its face in contact with the multifibre fabric and sewn along one short side.

10.3.3.2 When testing unions in which one fibre predominates on one side and another fibre on the other side, two separate tests shall be carried out by making two composite specimens, so that each side is in contact with the multifibre adjacent fabric.

10.3.3.3 In the case of multicoloured or printed fabrics, all the different colours of the design shall be tested in contact with all six components of the multifibre adjacent fabric strip. It may be necessary to carry out more than one test.

10.3.3.4 If the specimen is yarn or loose fibre, an amount approximately equal to that of the mass of the multifibre adjacent fabric is evenly spread over the multifibre adjacent fabric, with the yarns laid at right angles to the individual strips. This is then covered with an equal size piece of a lightweight, non-staining quality of polypropylene fabric, stitched along all four sides.

11 Conditioning

11.1 Special conditioning of specimens and of adjacent fabrics used with them is not usually necessary, but they shall be neither moist nor very dry.

11.2 For tests in which differences in moisture content of the specimen and adjacent fabric will influence the results, all fabrics shall be in a standard condition, i.e. in moisture equilibrium with air having a temperature of 20 °C ± 2 °C and relative humidity (RH) of 65 % ± 4 % in accordance with ISO 139.

For standard and alternative standard atmospheres for conditioning and testing, see ISO 139.

12 The “Procedure” clause

12.1 Under this heading, in each method are described the series of operations through which the specimen is taken, including the assessment of colour change and staining of adjacent fabrics. The use of test-control specimens is specified in some of the methods to ensure that the tests have been conducted correctly.

12.2 Tolerances are given for numerical values of dimensions, temperatures and times that are considered critical. If no tolerance is given, the precision of the measurements need be only that to be expected when using common instruments and reasonable care. The precision is further indicated by the number of significant figures in the values given.

12.3 Liquor ratio means the ratio of the volume of the liquor used in the treatment, expressed in millilitres (ml), to the mass of the specimen or the composite specimen (specimen plus adjacent fabric), expressed in grams (g).

12.4 Wetting out. When wetting specimens, special care shall be taken to ensure that they are uniformly saturated. In particular, when wool or materials containing wool are wetted out, it is necessary for them to be immersed in Grade 3 water complying with ISO 3696 and thoroughly kneaded either by hand or with a mechanical device, for example the flattened end of a glass rod.

12.5 Spotting. For tests in which the material is spotted with water or a reagent and the surface rubbed with a glass rod to ensure penetration, care shall be taken not to raise the surface of the material, otherwise there will be a change in the reflection of light and hence in appearance.

12.6 Wetting to 100 % increase in mass. When the material is to be wetted to contain its own mass of liquor, it may be saturated with the liquor and then drawn between two rubber rollers or squeezed by means of a rubber roller on a glass plate, or centrifuged. Wringing by hand does not give uniform wetting.

12.7 Temperatures are given in degrees Celsius (°C), usually with a tolerance of ±2 °C. For reliable results, continuous temperature control is essential.

13 Fastness of dyes

13.1 As the fastness of a dye depends on the depth of colour, it is necessary to specify standard depths which are to be used by dye manufacturers. A main range of standard depths, referred to as 1/1 standard depths, is recommended in 18 hues and is to be used whenever possible.

13.2 Supplementary ranges with double the depth of colour (referred to as 2/1 standard depths), and weaker colour (referred to as 1/3, 1/6, 1/12 and 1/25 standard depths), are also recommended and are to be used whenever additional fastness data are required.

13.3 In the case of navy blues and blacks, only two standard depths are recommended, namely:

— navy blue/light (N/L), black/light (B/L);

— navy blue/dark (N/Dk), black/dark (B/Dk).

Whenever possible, dye manufacturers' pattern cards shall provide fastness ratings at both depths.

13.4 These standard depths shall be prepared on a matt material (wool gabardine or printed card). Master sets of the standard depths are filed in certain countries for reference.

13.5 These standard depths are not subjected to any fastness test, but merely indicate at what depth of colour the fastness figures of dye manufacturers have been obtained, irrespective of dye or fibre.

14 Assessment of colour fastness

14.1 General conditions

Colour fastness is assessed separately with respect to change in colour of the specimen in the test and with respect to staining of adjacent fabrics. Specimens and adjacent fabrics shall have cooled after drying and shall have regained their normal moisture content before the assessment, except when otherwise specified.

Any loose fibres from the specimen adhering to the adjacent fabrics shall be removed before assessment of staining.

14.2 Colour fastness with respect to change in colour

The change which occurs in a test may be a change in lightness, chroma or hue, or any combination of these.

Regardless of the character of the change, the assessment is based upon the magnitude of the visual contrast between the specimen after the test and a specimen of the original material. This contrast is compared visually with the contrast represented by the five or nine pairs of colour chips (or swatches of fabric), ranging in both cases from a rating of 5, which illustrates no contrast, to a rating of 1, which illustrates a large contrast, as carried out according to ISO 105-A02. The fastness rating of the specimen is that number of the grey scale which corresponds to the contrast between the original and the treated specimens in the case of the nine-step scale; in the case of the five-step scale, if the contrast is judged to be nearer to the non-existent half-step, the appropriate half-step rating shall be given. Assessments to less than one half-step are not permitted. A rating of 5 is given only when there is no difference between the tested specimen and the original material.

In assessing the results of tests for colour fastness to light, the exposed specimens are compared with the scale of eight dyed blue wool reference fabrics, which have been exposed simultaneously. In addition, the grey scale for assessing change in colour is used as a means of defining the extent to which fading shall be carried out in the test (see ISO 105-B01 to ISO 105-B07).

In some tests, changes occur in the surface appearance of the specimen (for example, pile arrangement, structure, lustre, etc.) in addition to the change in colour. In such cases, the surface of the specimen shall be restored, if possible, to its original condition by combing or brushing, etc. If this restoration is not possible, then the fact that the resultant rating gives not only the change in colour but also the overall change in appearance shall be noted in the test report (see Clause 16).

For certain types of textile products, a simple wetting can create an apparent difference in colour compared with a fabric which has not been wetted, and this is not due to a real change in colour. This colour difference is due to a modification of the surface of the fabric or to a migration of the finish. In this case, evaluation shall be made by comparison with the original fabric which has been wetted and not with the original fabric. The original fabric, placed horizontally, is wetted superficially and evenly by spraying with distilled water, avoiding formation of drips, and is left to dry. If this procedure has been conducted, details shall be included in the test report (see Clause 16).

In case of dispute, carry out instrumental assessment according to ISO 105-A05.

14.3 Colour fastness with respect to staining

The degree of staining of the adjacent fabric, either by absorption of dye from the bath or by direct transfer of colour from the specimen, is assessed by visual inspection of the side of the adjacent fabric which was in contact with the specimen; the colour of the bath is ignored, unless otherwise specified (for example, in the dry cleaning test).

For assessing staining, the five- or nine-step scale in accordance with ISO 105-A03 is used in a manner similar to that described for assessing change in colour in 14.2. Staining is assessed for each type of adjacent fabric in the test, staining at the stitching being ignored. If the adjacent fabric undergoes any visual change when subjected to a test in the absence of a specimen, a sample of the adjacent fabric which has been treated in this manner shall be used as the reference sample for the assessment of staining.

In case of dispute, carry out an instrumental assessment according to ISO 105-A04.

14.4 Influence of pretreatments and after-treatments

It is well known that the fastness of a dyeing obtained with a given dyestuff depends on the amount of dye, the substrate and the treatments applied to the textile material before, during or after dyeing. It follows that fastness is not a property of the dye itself, but only of a given dyeing.

14.5 Simple checks on colour fastness

The existence of a simple method of checking the colour fastness of a dyed material by reference to a reference dyeing is extremely useful for authorities receiving goods in large quantities, who wish to determine whether these are comparable with an accepted piece.

Where it is not essential to determine the exact colour fastness rating, it may be sufficient to compare the material being investigated with a standard dyeing. This method is used when it is necessary to establish only whether the colour fastness of the specimen to a particular agent is greater than, equal to, or less than that of the reference dyeing.

15 Conditions of viewing and illumination in assessing colour fastness

In assessing colour fastness, a piece of the original material and the tested specimen, or the undyed and stained adjacent fabrics, are arranged side by side in the same plane and oriented in the same direction.

Two or more layers are used, if necessary, to avoid effects of the other backing on the appearance. The appropriate grey scale is placed nearby in the same plane. For optimum precision, the areas of contrast to be compared shall be approximately of the same size and shape; this can be achieved by the use of a mask of neutral grey colour approximately midway between that illustrating Grade 1 and that illustrating Grade 2 of the grey scale for assessing change in colour (that is approximately Munsell N5) and of a size equal to that of the grey scale steps. The surrounding field is of the same uniform grey.

As large a surface as possible shall be used for the assessment, and the openings in the mask shall cover the area that will be assessed (e.g. staining mark). In order to obtain reliable test results, the samples shall be masked with a material that is identical in colour to the sleeve that is used to mask the test strip being used. (See ISO 105-A02 and ISO 105-A03.)

The surfaces to be compared are illuminated by a source that complies with the CIE standard illuminant D65 (see CIE Publication No. 51) with an illumination of 600 lx or more. The light is incident upon the surfaces at an angle of approximately 45°, and the direction of viewing is approximately along the perpendicular to the plane of the surfaces.

16 Test report

Under this heading, in each method is indicated the information to be supplied in the test report. In addition to fastness ratings, where applicable, information on the following shall be given:

a) a reference to the part of ISO 105 used for the basis of the testing;

b) type of adjacent fabric used (see 9.5.1);

c) when applicable, the method of yarn preparation used (see 10.2.2);

d) when the surface appearance of the test specimen cannot be restored, that the rating includes the overall change in appearance (see 14.2);

e) when applicable, that the rating is made by comparison with an original fabric which has been wetted (see 14.2);

f) any deviations from the test procedure.

Bibliography

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

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

[3] ISO 105-B03, *Textiles — Tests for colour fastness — Part B03: Colour fastness to weathering: Outdoor exposure*

[4] ISO 105-B04, *Textiles — Tests for colour fastness — Part B04: Colour fastness to artificial weathering: Xenon arc fading lamp test*

[5] ISO 105-B05, *Textiles — Tests for colour fastness — Part B05: Detection and assessment of photochromism*

[6] ISO 105-B06, *Textiles — Tests for colour fastness — Part B06: Colour fastness and ageing to artificial light at high temperatures: Xenon arc fading lamp test*

[7] ISO 105-B07, *Textiles — Tests for colour fastness — Part B07: Colour fastness to light of textiles wetted with artificial perspiration*

[8] ISO 105-F10, *Textiles — Tests for colour fastness — Part F10: Specification for adjacent fabric: Multifibre*

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