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**Textiles — Tests for colour fastness —
Part A : General principles**

Textiles — Essais de solidité des teintures — Partie A : Principes généraux

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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. Every 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

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Contents of ISO 105

ISO 105/A Textiles — Tests for colour fastness —

Part A : General principles

- A01 General principles of testing
- A02 Grey scale for assessing change in colour
- A03 Grey scale for assessing staining

ISO 105/B Textiles — Tests for colour fastness —

Part B : Colour fastness to light and weathering

- B01 Colour fastness to light : Daylight
- B02 Colour fastness to artificial light : Xenon arc fading lamp test
- B03 Colour fastness to weathering : Outdoor exposure
- B04 Colour fastness to weathering : Xenon arc
- B05 Detection and assessment of photochromism

ISO 105/C Textiles — Tests for colour fastness —

Part C : Colour fastness to washing and laundering

- C01 Colour fastness to washing : Test 1
- C02 Colour fastness to washing : Test 2
- C03 Colour fastness to washing : Test 3
- C04 Colour fastness to washing : Test 4
- C05 Colour fastness to washing : Test 5
- C06 Colour fastness to domestic and commercial laundering

ISO 105/D Textiles — Tests for colour fastness —

Part D : Colour fastness to dry cleaning

- D01 Colour fastness to dry cleaning
- D02 Colour fastness to rubbing : Organic solvents

ISO 105/E Textiles — Tests for colour fastness —

Part E : Colour fastness to aqueous agencies

- E01 Colour fastness to water
- E02 Colour fastness to sea water
- E03 Colour fastness to chlorinated water (swimming-bath water)
- E04 Colour fastness to perspiration
- E05 Colour fastness to spotting : Acid
- E06 Colour fastness to spotting : Alkali
- E07 Colour fastness to spotting : Water
- E08 Colour fastness to water : Hot water
- E09 Colour fastness to potting
- E10 Colour fastness to decatizing
- E11 Colour fastness to steaming
- E12 Colour fastness to milling : Alkaline milling
- E13 Colour fastness to acid-felting : Severe
- E14 Colour fastness to acid-felting : Mild

ISO 105/F Textiles — Tests for colour fastness —

Part F : Standard adjacent fabrics

- F01 Specification for standard adjacent fabric : Wool
- F02 Specification for standard adjacent fabric : Cotton and viscose

- F03 Specification for standard adjacent fabric : Polyamide
- F04 Specification for standard adjacent fabric : Polyester
- F05 Specification for standard adjacent fabric : Acrylic
- F06 Specification for standard adjacent fabric : Silk

- ISO 105/G Textiles — Tests for colour fastness —**
Part G : Colour fastness to atmospheric contaminants
- G01 Colour fastness to nitrogen oxides
 - G02 Colour fastness to burnt gas fumes
 - G03 Colour fastness to ozone in the atmosphere

- ISO 105/J Textiles — Tests for colour fastness —**
Part J : Measurement of colour and colour differences
- J01 Method for the measurement of colour and colour differences

- ISO 105/N Textiles — Tests for colour fastness —**
Part N : Colour fastness to bleaching agencies
- N01 Colour fastness to bleaching : Hypochlorite
 - N02 Colour fastness to bleaching : Peroxide
 - N03 Colour fastness to bleaching : Sodium chlorite : Mild
 - N04 Colour fastness to bleaching : Sodium chlorite : Severe
 - N05 Colour fastness to stoving

- ISO 105/P Textiles — Tests for colour fastness —**
Part P : Colour fastness to heat treatments
- P01 Colour fastness to dry heat (excluding pressing)
 - P02 Colour fastness to pleating : Steam pleating

- ISO 105/S Textiles — Tests for colour fastness —**
Part S : Colour fastness to vulcanizing
- S01 Colour fastness to vulcanizing : Hot air
 - S02 Colour fastness to vulcanizing : Sulphur monochloride
 - S03 Colour fastness to vulcanizing : Open steam

- ISO 105/X Textiles — Tests for colour fastness —**
Part X : Tests not included in parts A to S or part Z
- X01 Colour fastness to carbonizing : Aluminium chloride
 - X02 Colour fastness to carbonizing : Sulphuric acid
 - X03 Colour fastness to chlorination
 - X04 Colour fastness to mercerizing
 - X05 Colour fastness to organic solvents
 - X06 Colour fastness to soda boiling
 - X07 Colour fastness to cross-dyeing : Wool
 - X08 Colour fastness to degumming
 - X09 Colour fastness to formaldehyde
 - X10 Assessment of migration of textile colours into polyvinyl chloride coatings
 - X11 Colour fastness to hot pressing
 - X12 Colour fastness to rubbing
 - X13 Colour fastness of wool dyes to processes using chemical means for creasing, pleating and setting
 - X14 Colour fastness to acid chlorination of wool: Sodium dichloroisocyanurate

- ISO 105/Z Textiles — Tests for colour fastness —**
Part Z : Colorant characteristics
- Z01 Colour fastness to metals in the dye-bath : Chromium salts
 - Z02 Colour fastness to metals in the dye-bath : Iron and copper

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A01 General principles of testing

1 INTRODUCTION

1.1 This section provides general information about the methods for testing colour fastness of textiles for the guidance of users. The uses and the 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.

1.2 By colour fastness is meant the resistance of the colour of textiles to the different agencies to which textiles may be exposed during manufacture and the subsequent use. The change of colour and staining of undyed adjacent fabrics are assessed as fastness ratings. Other visible changes of the textile material under test, for example surface effects, change in gloss or shrinkage, should be considered as separate properties and reported as such. Any loose fibres from the specimen adhering to the adjacent fabrics shall be removed before assessment of staining.

1.3 The methods may 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 textile is then tested in the usual way.

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

1.5 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 should be interpreted according to the particular needs of each user. They provide, however, a common basis for testing and reporting colour fastness.

2 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 agency 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.

3 OUTLINE OF FORM OF THE METHODS

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

- "Introduction"
- "Scope and field of application"
- "Principle"
- "References"
- "Apparatus and reagents" (or "Standards and apparatus")
- "Test specimen"
- "Procedure"
- "Test report"
- "Note(s)"

4 "SCOPE AND FIELD OF APPLICATION"

4.1 Under this heading in each method are given intended use of the method, its limitations and the definitions of any terms that may not be clear.

4.2 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 cloth not mentioned in the method (whether manufactured wholly from one fibre or from a mixture of fibres) can be submitted to test. In such cases it is necessary to verify and note whether the procedure is likely to cause any alteration in the fibre 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.

5 "PRINCIPLE" (OF METHOD)

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 he is seeking.

6 "REFERENCES"

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

7 "APPARATUS AND REAGENTS" (OR "STANDARDS AND APPARATUS")

7.1 Under this heading in each method are described the equipment and supplies required for the test.

7.2 **Test solutions** should be prepared using distilled water. The concentrations of baths are given in millilitres per litre (ml/l) or grams per litre (g/l). The qualities of chemicals to be used are given in each method. For crystalline substances the amount of water of crystallization is given and, for liquids, the relative density at 20 °C.

7.3 By **adjacent fabric** is meant 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.

7.3.1 **Single-fibre adjacent fabrics**, if not otherwise specified, should be of plain weave, medium mass per unit area and free from chemically damaged fibres, finishes, residual chemicals, dyes or fluorescent whitening agents. The fluidity value of cotton adjacent fabric may not exceed 5 rhes when measured by the Cu En method.

7.3.2 Properties and preparation of the single-fibre adjacent fabrics are given under the different adjacent fabric specifications.

7.3.3 **Multi-fibre adjacent fabrics** are made of yarns of various generic kinds of fibres each of which forms a stripe of at least 1,5 cm width providing even thickness of the fabric. The staining properties of generic fibres used in single-fibre and multi-fibre adjacent fabrics must be identical.

7.4 By **standard of fading** is meant a dyed fabric of similar appearance as the test control (see 8.4), showing the colour to which the test control should fade during the test. Test controls are produced by a central organization and are made available through national standards bodies.

7.5 Selection and use of adjacent fabrics

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, including dimensions.

7.5.1 Types of adjacent fabrics

Either of the following procedures may be used.

a) Two single-fibre adjacent fabrics. The first adjacent fabric should 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 should be that indicated in the individual test or as otherwise specified.

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

7.5.2 Dimensions and use of adjacent fabrics

7.5.2.1 When single-fibre adjacent fabrics are used, these shall be of the same dimensions as the specimen under test (normally 10 cm × 4 cm). As a general principle, each surface of the specimen is completely covered by each of the adjacent fabrics. Special requirements are outlined in 8.6.

7.5.2.2 When a multi-fibre adjacent fabric is used, this shall be of the same dimensions as the specimen under test (normally 10 cm × 4 cm). As a general principle, it shall cover the face side only of the specimen.

8 "TEST SPECIMEN"

8.1 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 below.

8.2 By **specimen** is meant a small piece of 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.

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8.3 By **composite specimen** is meant the specimen together with one or two selected adjacent fabrics used for assessing staining.

8.4 By **test-control specimen** is meant 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.

8.5 Preparation of specimens

8.5.1 Fabrics

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

8.5.2 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.

8.5.3 Loose fibres

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

8.6 Preparation of composite specimens

8.6.1 Sewing threads must be free from fluorescent brightening agents.

8.6.2 Composite specimens using two single-fibre adjacents :

8.6.2.1 If the specimen is fabric, it is placed between the two adjacent fabrics and sewn along one short side except in the case of certain methods involving mechanical action, when the composite specimen is sewn along all four sides.

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

8.6.2.3 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.

8.6.2.4 If the specimen is yarn or loose fibre, an amount approximately equal to one-half 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 with additional stitching at about 1 cm intervals; in the case of yarn specimens, this stitching shall be at right angles to the direction of the yarns.

8.6.3 Composite specimens using one multi-fibre adjacent :

8.6.3.1 If the specimen is fabric, it is placed with its face in contact with the multi-fibre fabric and sewn along one short side except in the case of certain methods involving mechanical action, when the composite specimen is sewn along all four sides.

8.6.3.2 When testing unions in which one fibre predominates on one side and another fibre on the other side, two composite specimens must be prepared so that each side is in contact with the multi-fibre adjacent fabric.

8.6.3.3 If the specimen is yarn or loose fibre, an amount approximately equal to that of the mass of the multi-fibre adjacent fabric is evenly spread over the multi-fibre adjacent fabric, yarns being laid at right angles to the individual strips. This is then covered with an equal size piece of a light-weight, non-staining quality of polypropylene fabric, stitched along all four sides and in addition between each pair of adjacent strips comprising the multi-fibre adjacent fabric.

9 CONDITIONING

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

9.2 For tests in which differences in moisture content of the specimen and adjacent fabric will influence the results, all fabrics should be in a standard condition, i.e. in moisture equilibrium with air having a temperature of 20 ± 2 °C and relative humidity of 65 ± 2 %.

NOTE — In tropical and subtropical countries, material may be regarded as being in the standard condition when it is in moisture equilibrium with air having a temperature of 27 ± 2 °C and relative humidity of 65 ± 2 %.

10 "PROCEDURE"

10.1 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.

10.2 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.

10.3 By **liquor ratio** is meant 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).

10.4 Wetting out. When wetting specimens, special care should 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 softened, distilled or deionized water and *either* thoroughly kneaded by hand or with a mechanical device, for example the flattened end of a glass rod, *or* placed in a suitable flask, evacuated using a water suction pump or similar apparatus.

10.5 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 should be taken not to raise the surface of the material, otherwise there will be change in the reflection of light and hence in appearance.

10.6 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.

10.7 Temperatures are given in degrees Celsius ($^{\circ}\text{C}$), usually with a tolerance of $\pm 2^{\circ}$. For reliable results, continuous temperature control is essential.

11 FASTNESS OF DYES

11.1 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.

11.2 Supplementary ranges twice as deep (referred to as 2/1 standard depths), and weaker (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.

11.3 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 should provide fastness ratings at both depths.

11.4 These standard depths should be prepared on a matt material (wool gaberdine or printed card). Master sets of the standards depths are filed in certain countries for reference.

11.5 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.

12 ASSESSMENT OF COLOUR FASTNESS

12.1 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 should have cooled after drying and should have regained their normal moisture content before the assessment, except when otherwise specified.

12.2 Colour fastness with respect to change in colour. The change which occurs in a test may be a change in depth of colour (i.e. saturation), a change in hue, a change in brightness, 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 cloth), ranging in both cases from 5, which illustrates no contrast, to 1, which illustrates a large contrast, these scales being specified in section A02, *Grey scale for assessing change in colour*. 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 standard dyed blue wool cloths, 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 should be carried out in the test (see sections B01 to B04).

In some tests, changes occur in the surface appearance of the specimen (for example pile arrangement, structure, lustre, etc.) in addition to 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 should be noted in the test report.

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 should be attributed to a modification of the surface of the fabric or to a migration of the finish. In this case, evaluation should 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.

12.3 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 if not otherwise specified (for example, in the dry cleaning test).

For assessing staining, the five- or nine-step scale specified in section A03, *Grey scale for assessing staining*, is used in a manner similar to that described for assessing change in colour in 12.2. 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 should be used as the reference sample for the assessment of staining.

12.4 Influence of pre-treatments and after-treatments. It is well known that the fastness of 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.

12.5 Simple checks on colour fastness. The existence of a simple method of checking the colour fastness of a dyed cloth by reference to a standard 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 cloth

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 agency is greater than, equal to, or less than that of the reference dyeing.

13 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 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 should be approximately of the same size and shape; if necessary, this can be achieved by the use of a mask of neutral grey colour approximately mid-way between that illustrating grade 1 and that illustrating grade 2 of the grey scale for assessing change in colour (this is approximately Munsell N5) and of a size equal to that of the grey scale steps. The surrounding field is the same uniform grey. The surfaces to be compared are illuminated by north sky light in the Northern hemisphere, south sky light in the Southern hemisphere, or an equivalent source 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.

14 "TEST REPORT"

Under this heading in each method is indicated the information to be supplied in the test report. In addition to fastness ratings, information is required to be given on the adjacent fabrics used and any deviations from the test procedure.

15 "NOTE(S)"

Under this heading in each method are given references to literature and other information not considered necessary for inclusion in the body of the test method.