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Textiles — Tests for colour fastness —

Part G01:
Colour fastness to nitrogen oxides

Textiles — Essais de solidité des teintures —

Partie G01: Solidité des teintures aux oxydes d’azote

Reference number
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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 documents 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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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information.

The committee responsible for this document is ISO/TC 38, *Textiles*, Subcommittee SC 1, *Tests for coloured textiles and colorants*.

This third edition cancels and replaces the second edition (ISO 105-G01:1993), which has been technically revised. It also incorporates the Technical Corrigendum ISO 105-G01:1993/Cor 1:1995. The main technical changes are the following:

a) the test-control fabric dyed with Disperse Blue 3 was deleted;

b) the test-control fabric dyed with Disperse Violet 1 and the test-control fabric dyed with Disperse Blue 56 were added.

ISO 105 consists of many parts designated by a part letter and a two-digit serial number (e.g. A01), under the general title *Textiles — Tests for colour fastness*. A complete list of these is given in ISO 105-A01.

Textiles — Tests for colour fastness —

Part G01:
Colour fastness to nitrogen oxides

1 Scope

This part of ISO 105 specifies two methods for determining the resistance of the colour of textiles of all kinds and in all forms to the action of nitrogen oxides produced during combustion of gas, coal, oil, etc., and when air is passed over heated filaments.

The two tests differ in severity; one or both of them are used, depending on the result obtained (7.2.4).

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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-F02, *Textiles — Tests for colour fastness — Part F02: Specification for cotton and viscose adjacent fabrics*

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

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

3 Principle

Specimens of textiles are exposed to nitrogen oxides in a closed container until either one or three test-control fabrics exposed simultaneously with the test specimens have changed in colour to a predetermined extent. The change in colour of each specimen is assessed with the grey scale.

4 Apparatus and materials

4.1 **Exposure chamber**, see Annex A.

4.2 **Nitric oxide**, from a commercially supplied cylinder or a generator (see Annex B).

WARNING — Nitric oxide is toxic. The maximum concentration in a working room should not exceed 6,7 mg/m^3.

4.3 **Sulfuric acid**, containing 1 100 g/l of H_2SO_4 (relative density 1,603).

4.4 **Sodium nitrite ($NaNO_2$)**, saturated solution in grade 3 water (4.13).

4.5 **Sodium hydroxide**, dilute solution (approximately 100 g/l of NaOH).

4.6 Urea solution, containing 10 g/l of urea (NH_2CONH_2), buffered to pH 7 by the addition of 0,4 g/l of sodium dihydrogen orthophosphate dihydrate ($NaH_2PO_4 \cdot 2H_2O$) and 2,5 g/l of disodium hydrogen orthophosphate dodecahydrate ($Na_2HPO_4 \cdot 12H_2O$), and containing 0,1 g/l or less of a rapid-wetting surface-active agent, for example, sodium dioctyl sulfosuccinate.

4.7 Test-control fabric

4.7.1 Test-control fabric dyed with Disperse Violet 1

A woven filament acetate is uniformly dyed in an open-width dyeing machine with 0,4 % (on mass of fabric) Cl Disperse Violet 1 (Colour Index, Third Edition) in a dye-bath containing 1 g/l of a dispersing agent at a liquor ratio of 10:1.

The fabric construction has both a taffeta and a satin side; for this test procedure, only the taffeta side will be considered.

The resistance of the test-control fabric to the action of nitric oxide should not be varied between the new lots. The supplier should confirm the performance of the new lot.[1]

4.7.2 Test-control fabric dyed with Disperse Blue 56

A woven filament acetate is uniformly dyed in an open-width dyeing machine with 0,8 % (on mass of fabric) CI Disperse Blue 56 (Colour Index, Third Edition) in a dye-bath containing 0,5 ml/l of a dispersing agent at a liquor ratio of 42:1.

The fabric construction has both a taffeta and a satin side; for this test procedure, only the taffeta side will be considered.

The resistance of the test-control fabric to the action of nitric oxide should not be varied between the new lots. The supplier should confirm the performance of the new lot.[2]

4.8 Standard of fading

4.8.1 Standard fading fabric for test-control fabric dyed with Disperse Violet 1

The regenerated cellulose woven taffeta is a fabric of similar appearance to the test-control fabric (4.7.1), dyed to match an average of faded test-control fabric.[3]

4.8.2 Standard of fading for test-control fabric dyed with Disperse Blue 56

It is considered that the standard of fading is completed when a faded test-control fabric (4.7.2) is observed to have a contrast equal to grade 3-4 on the grey scale.

4.9 Syringe, for injecting oxide into the exposure chamber (4.1).

A medical syringe is best suited to the injection of the nitric oxide. For a larger exposure chamber, the gas can also be measured and transferred from the nitric oxide reservoir to the exposure chamber by means of a gas burette.

4.10 Undyed fabric, of the same kind(s) of fibre as the test specimen.

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[1] Test-control fabric dyed with Disperse Violet 1 is commercially available from Testfabrics, Inc. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO this product.

[2] Test-control fabric dyed with Disperse Blue 56 is commercially available from the Japanese Standards Association. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO this product.

[3] The standard fading fabric is commercially available from Testfabrics, Inc. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO this product.

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

4.12 Means for providing the standard atmosphere for testing, specified in Clause 5.

4.13 Grade 3 water, according to ISO 3696.

5 Conditioning and testing atmosphere

The standard temperate atmosphere for testing textiles (see ISO 139), i.e. a relative humidity of (65 ± 4) % and temperature of (20 ± 2) °C, shall be used for conditioning and testing.

6 Test specimens

6.1 If the textile to be tested is fabric, use a test specimen measuring 40 mm × 100 mm.

6.2 If the textile to be tested is yarn, knit it into fabric and use a piece measuring 40 mm × 100 mm or wind it closely round a frame of rigid inert material measuring 40 mm × 100 mm to form, on each side, a layer having only the thickness of the yarn.

6.3 If the textile to be tested is loose fibre, comb and compress enough of it to form a sheet measuring 40 mm × 100 mm and sew the sheet on a piece of cotton adjacent fabric complying with ISO 105-F02 to support the fibre.

6.4 Cut a test specimen measuring 40 mm × 100 mm from the test-control fabric (4.7.1 or 4.7.2) and cut test specimens measuring 40 mm × 100 mm from the undyed fabric (4.10).

7 Procedure

7.1 Preliminary operations

7.1.1 Mount each test specimen by fastening the shorter side to a radial arm of the frame of the apparatus (see Figure A.1) by means of an adhesive or clips. When an adhesive is used, this shall be allowed to dry properly.

7.1.2 Up to 12 test specimens, each measuring 40 mm × 100 mm, may be mounted in this way for one test. If fewer test specimens are to be tested, fill up with cuttings of undyed fabric of the same kind to the total number of 12. The test-control fabric is fastened to the holder. Condition the test specimens and test-control fabric for at least 12 h in the atmosphere specified in Clause 5.

7.1.3 Place the frame with the test specimens inside the glass cylinder and then place the bell-jar on top; put the holder with the test-control fabric through the top plug-hole.

7.1.4 Adjust the rotational frequency of the fan to 200 min^{-1} to 300 min^{-1} and shield the apparatus from bright light.

7.1.5 Inject 0,65 ml of nitric oxide (4.2) for each litre of exposure chamber capacity into the bell-jar.

7.2 One-cycle test

7.2.1 Observe the test-control fabric and, when it has faded to the extent shown by the standard of fading (4.8.1 or 4.8.2), lift the bell-jar immediately and plunge the exposed test specimens and the exposed test-control fabric into the buffered urea solution (4.6) together with unexposed portions of the textile from which each test specimen was taken.

7.2.2 After immersion for 5 min, squeeze, rinse and dry the test specimens and unexposed portions by hanging them in air at a temperature not exceeding 60 °C.

7.2.3 Check that the test-control fabric has faded to the extent shown by the standard of fading (4.8.1 or 4.8.2) and, if so, assess the change in colour of each test specimen against the appropriate unexposed portion which has been immersed in the buffer solution, using the grey scale (4.11).

7.2.4 If a test specimen shows a contrast greater than grade 4, this one-cycle result shall be reported (see Clause 8) and the test completed. If the contrast is not greater than grade 4, the preliminary operations described in 7.1 shall be carried out on fresh test specimens, followed by the three-cycle test procedure described in 7.3.

7.3 Three-cycle test

7.3.1 Observe the test-control fabric and, when it has faded to the extent shown by the standard of fading (4.8.1 or 4.8.2), plunge test-control fabric into the buffered urea solution (4.6), replace it with another test-control fabric and inject an additional 0,2 ml of nitric oxide for each litre of exposure chamber capacity. When the second test-control fabric has faded to the extent shown by the standard of fading, plunge test-control fabric into the buffered urea solution (4.6), replace it with a third test-control fabric, and again add 0,2 ml of nitric oxide for each litre of exposure chamber capacity. When the third test-control fabric has faded to the extent shown by the standard of fading, lift the bell-jar immediately and plunge the exposed test specimens and the exposed test-control fabric into the buffered urea solution (4.6) together with unexposed portions of the textile from which each test specimen was taken.

7.3.2 After immersion for 5 min, squeeze, rinse and dry the test specimens and unexposed portions by hanging them in air at a temperature not exceeding 60 °C.

7.3.3 Check that each of the three test-control fabric has faded to the extent shown by the standard of fading and, if so, assess the change in colour of each test specimen against the appropriate unexposed portion which has been immersed in the buffer solution, using the grey scale (4.11).

7.3.4 This three-cycle result shall be reported (see Clause 8) and the test completed.

7.4 Conditioning

The test shall be conducted in the standard atmosphere for testing as specified in Clause 5. If no conditioning room is available in which the complete test can be carried out, the test specimen may be conditioned in the standard atmosphere for testing in a suitable apparatus and tested at room temperature. In this case, conditioned air (20 °C, 65 % relative humidity) shall be aspirated through the chamber for 15 min before introducing the nitric oxide. The conditioned air can be provided by passing air through a wash bottle containing a saturated solution of ammonium nitrate (NH_4NO_3) in contact with the solid phase at 20 °C. The inlet and outlet are closed during the test.

8 Test report

The test report shall include the following:

a) the date of test;

b) the number and year of publication of this part of ISO 105, i.e. ISO 105-G01:2016;

c) all details necessary for the identification of the test specimen tested;

d) the type of the test-control fabric used;

e) the numerical rating for the change in colour of each test specimen using the grey scale;

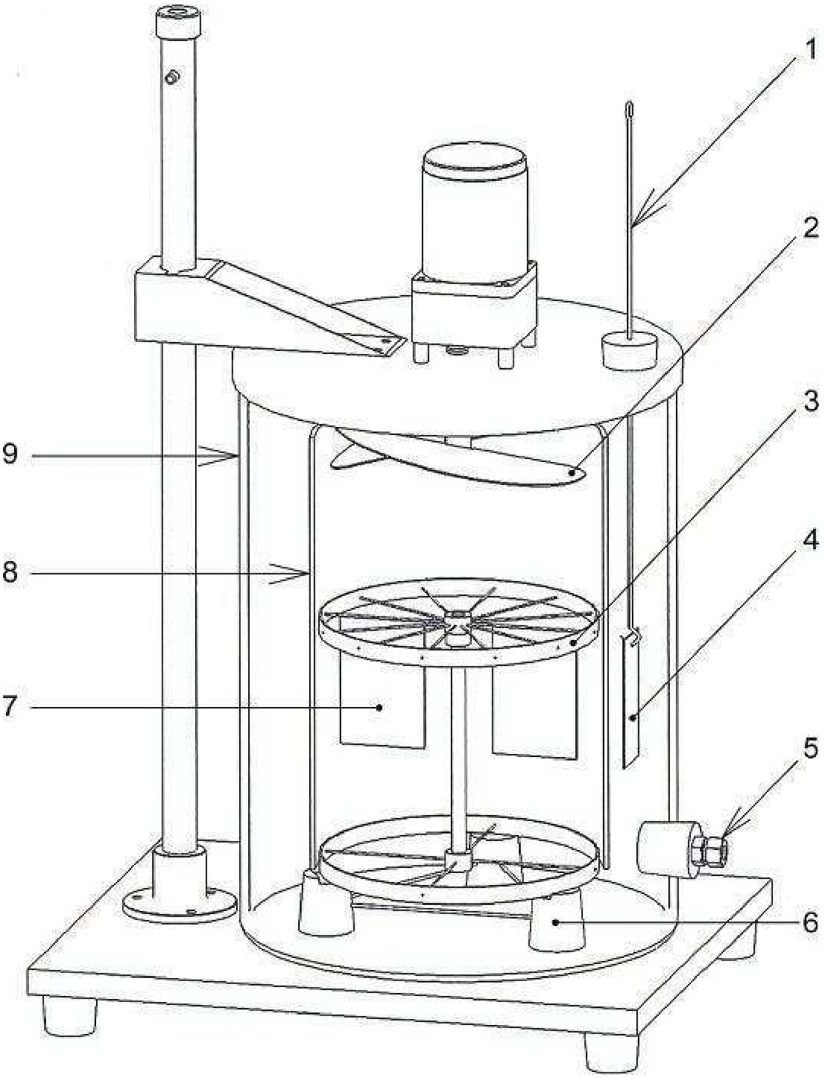
f) the number of cycles of exposure (one or three).

Annex A
(normative)

Test apparatus

Suitable test apparatus is shown in Figure A.1 and consists of a 15 l capacity bell-jar having two plug-holes on the top and one plug-hole near the bottom. Inside the bell-jar are placed a glass cylinder, 165 mm ± 2 mm in diameter and 225 mm ± 1 mm in height, standing on three supports made of inert material (for example, silicone rubber or glass), and a stainless-steel frame for suspending the test specimens. Through one of the top plug-holes passes a spindle bearing a stainless-steel or plastics fan, 145 mm ± 5 mm in diameter, adjusted so that its lower edge is approximately 20 mm from the upper rim inside the cylinder. A stainless-steel holder is let through the other top plug-hole and holds the test-control fabric. This holder is located between the glass cylinder and the bell-jar. A ground stainless-steel stopper is inserted in the bottom plug-hole and contains a screwed insert within which a silicone-rubber membrane is fitted, the gas being introduced through this membrane.

Any other apparatus yielding the same results can also be used. Care shall be taken to carry out the test under identical conditions, i.e. the ratio between number of test specimens, space in the test chamber and amount of gas shall always be the same.



Key

1	holder (stainless-steel)
2	fan
3	frame (stainless-steel)
4	test-control fabric
5	gas inlet
6	supports
7	test specimen
8	glass cylinder
9	bell-jar

Figure A.1 — Test apparatus

Annex B
(normative)

Nitric oxide generation apparatus

WARNING — The filling, emptying, dismantling and cleaning of the apparatus should be carried out with great care under an exhaust hood or out of doors, and with the hands and eyes suitably protected against the concentrated acid.

B.1 General

Suitable apparatus for the generation of nitric oxide is shown in Figure B.1. Nitric oxide gas is generated by slowly running a cold saturated solution of sodium nitrite (4.4) from a dropping funnel with discharge tube into sulfuric acid (4.3), contained in a double-necked glass flask of 1 000 ml capacity. The gas from either the generator or a commercial cylinder is conveyed into a triple-necked glass flask equipped with a displacement vessel (nitric oxide reservoir) after having passed over dilute sodium hydroxide solution (4.5) in a safety-trap flask. Gas is taken from the reservoir by means of a medical syringe (4.9), the needle of which is passed through a silicone-rubber membrane located in a stainless-steel stopper; the needle is then passed through the silicone-rubber membrane in the bottom plug-hole of the bell-jar (see 7.1.5). The apparatus is operated as follows.

B.2 Starting up the apparatus

(Replacement of the air in the apparatus by nitric oxide)

Fill up the nitric oxide reservoir with water. Pour about 300 ml of sulfuric acid (4.3) into the gas generator. Pour 100 ml of saturated sodium nitrite solution (4.4) into the dropping funnel and approximately 100 ml of dilute sodium hydroxide solution (4.5) into the safety-trap flask. Close cock C, open cock A, and allow the sodium nitrite solution to flow slowly and dropwise through cock B, at the same time letting the gas formed escape through the discharge tube with cock A open. After about 30 s, open cocks C, D and E, close cock A, and fill the nitric oxide reservoir to about 75 % with gas. Close cock B, re-open cock A, and again allow the gas to escape. Repeat this procedure five times to ensure that the nitric oxide is free of air.

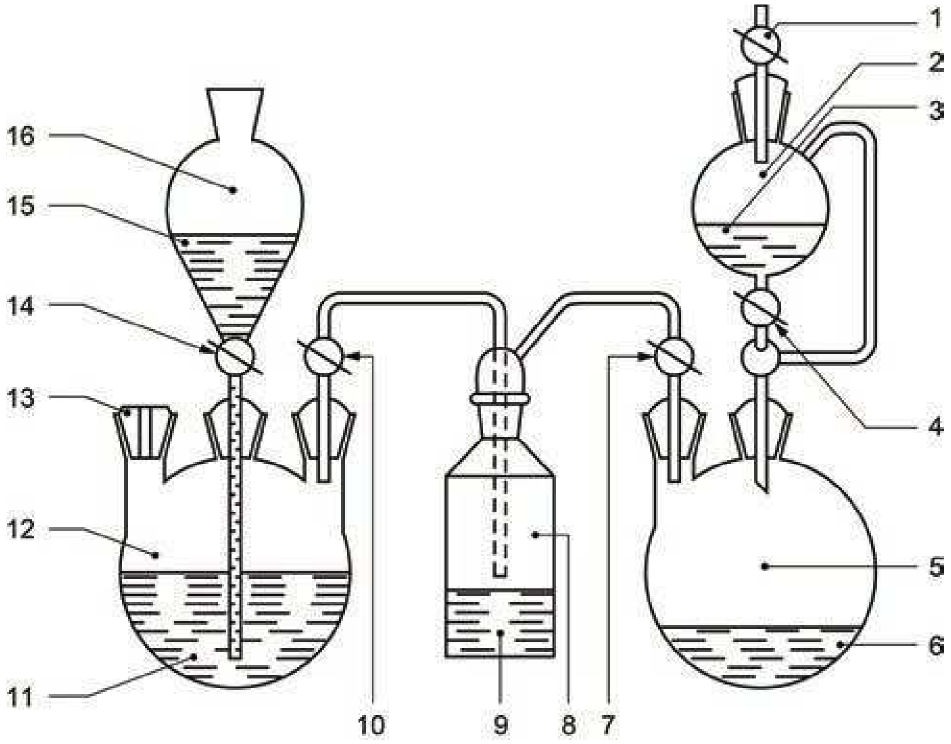
B.3 Continuous operation

After the nitric oxide reservoir has been filled and emptied five times, fill it with gas to only 50 % of its capacity, whereupon cocks B and D are closed, while cocks E and A are left open in order to prevent excess pressure in the generator. The gas may now be taken. Further gas is supplied to the reservoir by allowing a few more drops of sodium nitrite solution to react. It is permissible to fill the nitric oxide reservoir up to 90 % of its capacity only when a further supply of gas is prevented by closing cock D, but the gas generator shall then be kept open to the atmosphere via cocks A and C.

B.4 Refilling the gas generator

B.4.1 The pressure in the gas generator is released by closing cock D and opening cock A, so that it can then be dismantled, cleaned and refilled.

B.4.2 After re-assembly and re-stocking with sodium nitrite solution and sulfuric acid, the procedure described under B.2 is repeated.



Key

1	cock A	9	NaOH solution
2	dropping funnel with discharge tube	10	cock D
3	$NaNO_2$ solution	11	H_2O
4	cock B	12	nitric oxide reservoir
5	gas generator	13	nitric oxide extraction port
6	H_2SO_4 solution	14	cock E
7	cock C	15	H_2O
8	safety-trap flask	16	displacement vessel

Figure B.1 — Nitric oxide generator

Bibliography

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

[2] Colour Index Revised Third Edition

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