International Standard 105/G

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Textiles — Tests for colour fastness — Part G: Colour fastness to atmospheric contaminants

Textiles — Essais de solidité des teintures — Partie G: Solidité des teintures aux agents atmosphériques de dégradation

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

International Standard ISO 105/G was developed by Technical Committee ISO/TC 38, *Textiles*.

It was submitted directly to the ISO Council, in accordance with sub-clause 5.10.1 of part 1 of the Directives for the technical work of ISO.

This part of ISO 105 cancels and replaces group G of ISO 105-1978, originally published as part 5 of International Standard ISO 105/VI-1972, and part 1 of International Standard ISO 105/VII-1975.

NOTE — International Standard ISO 105 is presented in the form of parts. Each of these parts corresponds to a group and is split up into its different component sections. This form facilitates the replacement of existing sections by successive editions as necessary.

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INTERNATIONAL STANDARD **ISO 105-G01-1978 (E)**

Textiles — Tests for colour fastness

G01 Colour fastness to nitrogen oxides

1 SCOPE AND FIELD OF APPLICATION

1.1 This method is intended 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.

1.2 Two tests differing in severity are provided; one or both of them may be used depending on the requirement.

2 PRINCIPLE

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

3 REFERENCES

ISO 105 :

Section A01, *General principles of testing.*

Section A02, *Grey scale for assessing change in colour.*

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

4 APPARATUS AND REAGENTS

4.1 Exposure chamber (see 9.3).

4.2 Nitric oxide, from a commercially supplied cylinder or a generator (see 9.4).

CAUTION — Nitric oxide and other nitrogen oxides are toxic. The maximum concentration in a working room must not exceed 5 parts per million.

4.3 Sulphuric acid containing 1 100 g of H_2SO_4 per litre (relative density 1,603).

4.4 Sodium nitrite ($NaNO_2$), saturated solution in distilled water.

4.5 Sodium hydroxide, dilute solution (approximately 100 g of NaOH per litre).

4.6 Urea solution, containing, per litre, 10 g of urea ($NH_2.CO.NH_2$), buffered to pH 7 by the addition of 0,4 g of sodium dihydrogen orthophosphate dihydrate ($NaH_2PO_4.2H_2O$) and 2,5 g of disodium hydrogen orthophosphate dodecahydrate ($Na_2HPO_4.12H_2O$), and containing 0,1 g or less of a rapid wetting surface-active agent, for example sodium dioctyl sulphosuccinate.

4.7 Test control (see 9.1).

4.8 Standard of fading (see 9.2).

4.9 Syringe, for injection (see 9.5).

4.10 Undyed cloth of the same kind of fibres as the specimen.

4.11 Grey scale for assessing change in colour (see clause 3).

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

5 CONDITIONING AND TESTING ATMOSPHERE

The standard atmosphere for testing textiles (see clause 3), i.e. a relative humidity of 65 ± 2 % and temperature of 20 ± 2 °C, shall be used for conditioning and testing.

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6 TEST SPECIMEN

6.1 If the textile to be tested is fabric, use a specimen 10 cm × 4 cm.

6.2 If the textile to be tested is yarn, knit it into fabric and use a piece 10 cm × 4 cm or wind it closely round a frame of rigid inert material measuring 10 cm × 4 cm to form a layer having only the thickness of the yarn, on each side.

6.3 If the textile to be tested is loose fibre, comb and compress enough of it to form a sheet 10 cm × 4 cm and sew the sheet on a piece of cotton adjacent fabric to support the fibre.

6.4 Cut a specimen 10 cm × 4 cm of the test control (4.7) and cut specimens 10 cm × 4 cm of the undyed cloth (4.10).

7 PROCEDURE

7.1 Mount each specimen by fastening the shorter side to a radial arm of the frame of the apparatus (see 9.3 and figure 1) by means of an adhesive or clips. When an adhesive is used, this must be allowed to dry properly.

7.2 Up to 12 specimens, each 10 cm × 4 cm, may be mounted in this way for one test. If fewer 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 specimen is fastened to the test-control holder. Condition the specimens and test-control specimen for at least 12 h in the atmosphere specified in clause 5.

7.3 Place the frame with the specimens inside the glass cylinder and then place the bell-jar on top; put the holder with the test-control specimen through the top plug hole at the side and adjust the propeller as described in 9.3.

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

7.5 Inject 0,65 ml of nitric oxide (4.2) for each litre of exposure chamber capacity into the bell-jar (see 9.4).

7.6 One-cycle test

7.6.1 Observe the test-control specimen, and when it has faded to the extent shown by the standard of fading (see 9.2), lift the bell-jar immediately and plunge the treated specimens and the treated test-control specimen into the buffered urea solution (4.6) together with untreated portions of each specimen.

7.6.2 After immersion for 5 min, squeeze, rinse and dry the specimen and untreated portions by hanging them in air at a temperature not exceeding 60 °C.

7.6.3 Check that the test-control specimen has faded to the extent shown by the standard of fading (see 9.2) and, if so, assess the change in colour of each specimen against the appropriate untreated portion which has been immersed in the buffer solution, using the grey scale.

7.6.4 If a specimen shows a contrast greater than grade 4, this one-cycle result should be reported (see clause 8) and the test completed. If the contrast is not greater than grade 4, the test procedure described in 7.1 to 7.5 shall be carried out on fresh specimens followed by the three-cycle test procedure described in 7.7.

7.7 Three-cycle test

7.7.1 Observe the test-control specimen, and when it has faded to the extent shown by the standard of fading (see 9.2), plunge it into the buffered urea solution (4.6), replace it with another and inject an additional 0,2 ml of nitric oxide for each litre of exposure chamber capacity. When the second test-control specimen has faded to the extent shown by the standard of fading (see 9.2), plunge it into the buffered urea solution (4.6), replace it with a third, and again add 0,2 ml of nitric oxide for each litre of exposure chamber capacity. When the third test-control specimen has faded to the extent shown by the standard of fading (see 9.2), lift the bell-jar immediately and plunge the treated specimens and the treated test-control specimens into the buffered urea solution (4.6) together with untreated portions of each specimen.

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

7.7.3 Check that each of the three test-control specimens has faded to the extent shown by the standard of fading (see 9.2) and, if so, assess the change in colour of each specimen against the appropriate untreated portion which has been immersed in the buffer solution, using the grey scale.

7.8 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 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 nitrogen 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

Report the numerical rating for the change in colour of the specimen and state the number of cycles of exposure, one or three.

9 NOTES

9.1 Test control

Acetate is uniformly dyed in an open width dyeing machine with 0,4 % (on mass of fabric) CI Celliton FFRN (Disperse Blue 3, Colour Index, 3rd Edition) in a dye-bath containing 1 g/l of a neutral non-ionic dispersing agent at a liquor ratio of 10 : 1.

The dyeing begins at 40 °C and the temperature is raised to 80 °C within 30 min. The dyeing is continued for a further 60 min. The fabric is rinsed in cold water and dried.

The colour co-ordinates of this dyeing are $x = 0{,}198\,8$, $y = 0{,}190\,4$, $Y = 23{,}20$ using Illuminant C.

The tolerance may be 2,2 CIE LAB units maximum.

9.2 Standard of fading

This is a fabric of similar appearance dyed to match a faded specimen of the test control. Both the test control and the standard of fading can be obtained from the national standards organizations.

9.3 Testing apparatus

Suitable testing apparatus is shown in figures 1 and 2 and consists of a 15 litre 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 in diameter and 225 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 specimens. Through one of the top plug-holes passes a spindle bearing a stainless steel or plastics propeller, 140 mm in diameter, adjusted so that its lower edge is approximately 20 mm from the upper rim inside the cylinder. A stainless steel rod is let through the other top plug-hole and holds the test-control specimen. 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 must be taken to carry out the test under identical conditions, i.e. the ratio between number of specimens, space in the test chamber and amount of gas must always be the same.

9.4 CAUTION — The filling, emptying, dismantling and cleaning of the apparatus must 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.

Suitable apparatus for the generation of nitric oxide is shown in figure 3. 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 sulphuric 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 (gas 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, 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 7.5). The apparatus is operated as follows.

9.4.1 *Starting up the apparatus* (Replacement of the air in the apparatus by nitric oxide)

Fill up the gas reservoir with water. Pour about 300 ml of sulphuric 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 2, open cock 1, and allow the sodium nitrite solution to flow slowly and dropwise through cock 1, at the same time letting the gas formed escape through the discharge tube with cock 5 open. After about 30 s, open cocks 2, 3 and 4, close cock 5, and fill the gas reservoir to about 75 % with gas. Close cock 1, re-open cock 5, and again allow the gas to escape. This procedure shall be repeated five times to ensure that the nitric oxide is free of air.

9.4.2 *Continuous operation*

After the gas reservoir has been filled and emptied five times, it shall be filled with gas to only 50 % of its capacity, whereupon cocks 1 and 3 are closed, while cocks 4 and 5 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 gas reservoir up to 90 % of its capacity only when a further supply of gas is prevented by closing cock 3, but the gas generator must then be kept open to the atmosphere via cocks 5 and 2.

9.4.3 *Refilling the gas generator*

9.4.3.1 The pressure in the gas generator is released by closing cock 3 and opening cock 5, so that it can then be dismantled, cleaned and refilled.

9.4.3.2 After re-assembly and re-stocking with sodium nitrite solution and sulphuric acid, the procedure described under 9.4.1 is repeated.

9.5 Transfer of nitric oxide

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 gas reservoir to the exposure chamber by means of a gas burette.

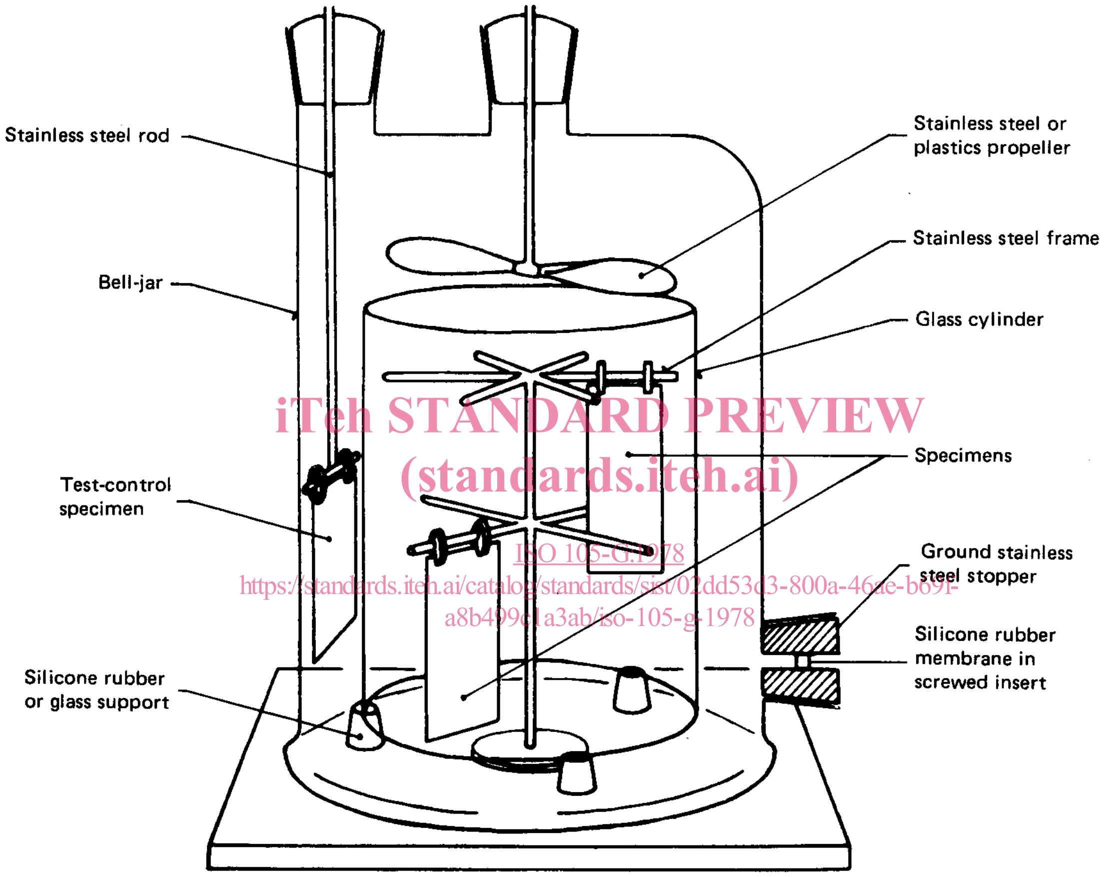

FIGURE 1 — **Exposure chamber**

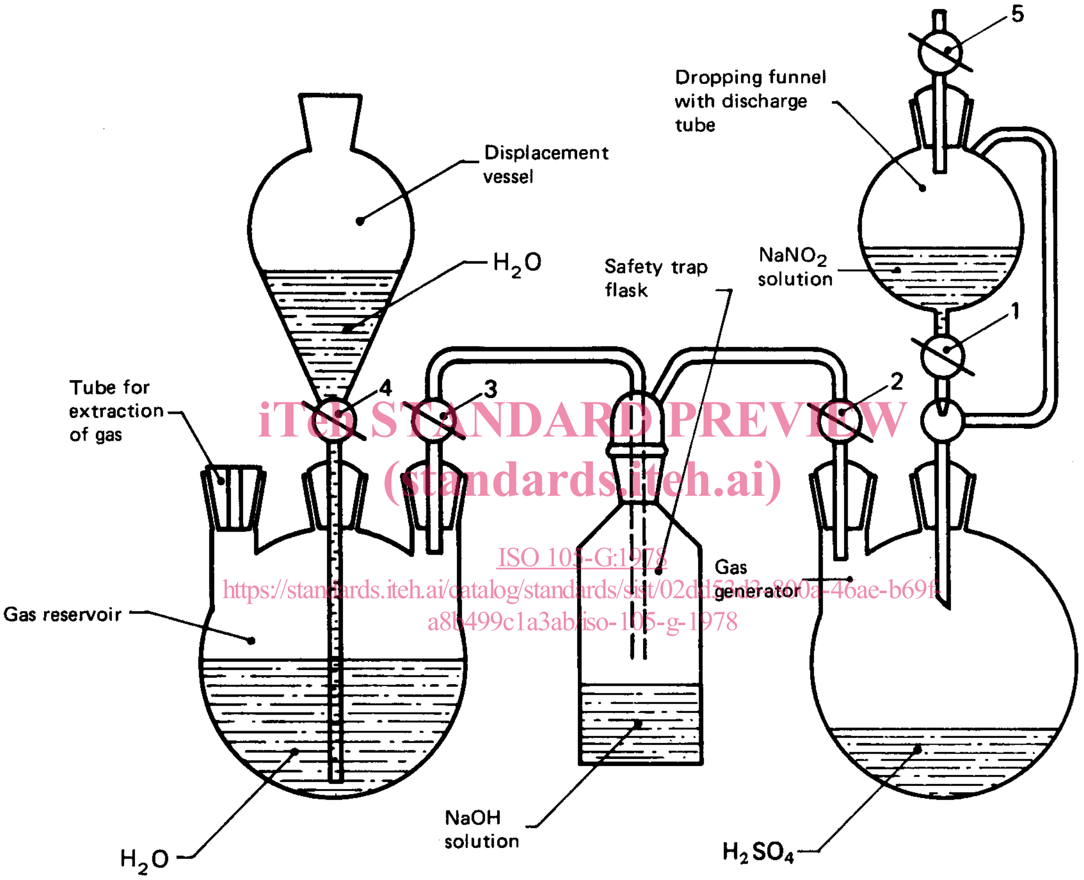

FIGURE 3 — **Nitric oxide generator**