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STANDARD

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Second edition
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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
ISO 105-G01:1993(E)

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.

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.

International Standard ISO 105-G01 was prepared by Technical Committee ISO/TC 38, *Textiles*, Sub-Committee SC 1, *Tests for coloured textiles and colorants*.

This second edition cancels and replaces the first edition (included in ISO 105-G:1978), of which it constitutes a minor revision.

ISO 105 was previously published in thirteen "parts", each designated by a letter (e.g. "Part A"), with publication dates between 1978 and 1985. Each part contained a series of "sections", each designated by the respective part letter and by a two-digit serial number (e.g. "Section A01"). These sections are now being republished as separate documents, themselves designated "parts" but retaining their earlier alphanumeric designations. A complete list of these parts is given in ISO 105-A01.

Annexes A and B form an integral part of this part of ISO 105.

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Textiles — Tests for colour fastness —

Part G01:
Colour fastness to nitrogen oxides

1 Scope

1.1 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.

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

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 105. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 105 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 105-A01:1989, *Textiles — Tests for colour fastness — Part A01: General principles of testing.*

ISO 105-A02:1993, *Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour.*

ISO 105-F:1985, *Textiles — Tests for colour fastness — Part F: Standard adjacent fabrics.*

ISO 139:1973, *Textiles — Standard atmospheres for conditioning and testing.*

3 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 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).

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 Sulfuric acid, containing 1 100 g of H_2SO_4 per litre (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 of NaOH per litre).

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

4.7 Test-control fabric, prepared as follows:

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

The tolerance may be 2,2 CIELAB units maximum.

Test-control fabric can be obtained from national standards organizations.

4.8 Standard of fading

This is a fabric of similar appearance to the test-control fabric (4.7), dyed to match a faded specimen of the test control. The standard of fading can be obtained from national standards organizations.

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

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

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 (see ISO 105-A01:1989, subclause 8.2).

5 Conditioning and testing atmosphere

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

6 Test specimens

6.1 If the textile to be tested is fabric, use a 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-F, section F02, to support the fibre.

6.4 Cut a specimen measuring 40 mm × 100 mm from the test-control fabric (4.7) and cut specimens measuring 40 mm × 100 mm from the undyed fabric (4.10).

7 Procedure

7.1 Preliminary operations

7.1.1 Mount each 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 specimens, each measuring 40 mm × 100 mm, 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.

7.1.3 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 fan as described in annex A.

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 (see annex B).

7.2 One-cycle test

7.2.1 Observe the test-control specimen and, when it has faded to the extent shown by the standard of fading (4.8), 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 the textile from which each specimen was taken.

7.2.2 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.

7.2.3 Check that the test-control specimen has faded to the extent shown by the standard of fading (4.8) 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 (4.11).

7.2.4 If a 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 specimens, followed by the three-cycle test procedure described in 7.3.

7.3 Three-cycle test

7.3.1 Observe the test-control specimen and, when it has faded to the extent shown by the standard of fading (4.8), 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, 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, 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 the textile from which each specimen was taken.

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

7.3.3 Check that each of the three test-control specimens has faded to the extent shown by the standard of fading 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 (4.11).

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 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 particulars:

a) the number and date of publication of this part of ISO 105, i.e. ISO 105-G01:1993;

b) all details necessary for the identification of the sample tested;

c) the numerical rating for the change in colour of each specimen;

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

Annex A
(normative)

Test apparatus

Suitable test apparatus is shown in figures A.1 and A.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 fan, 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 shall 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 shall always be the same.

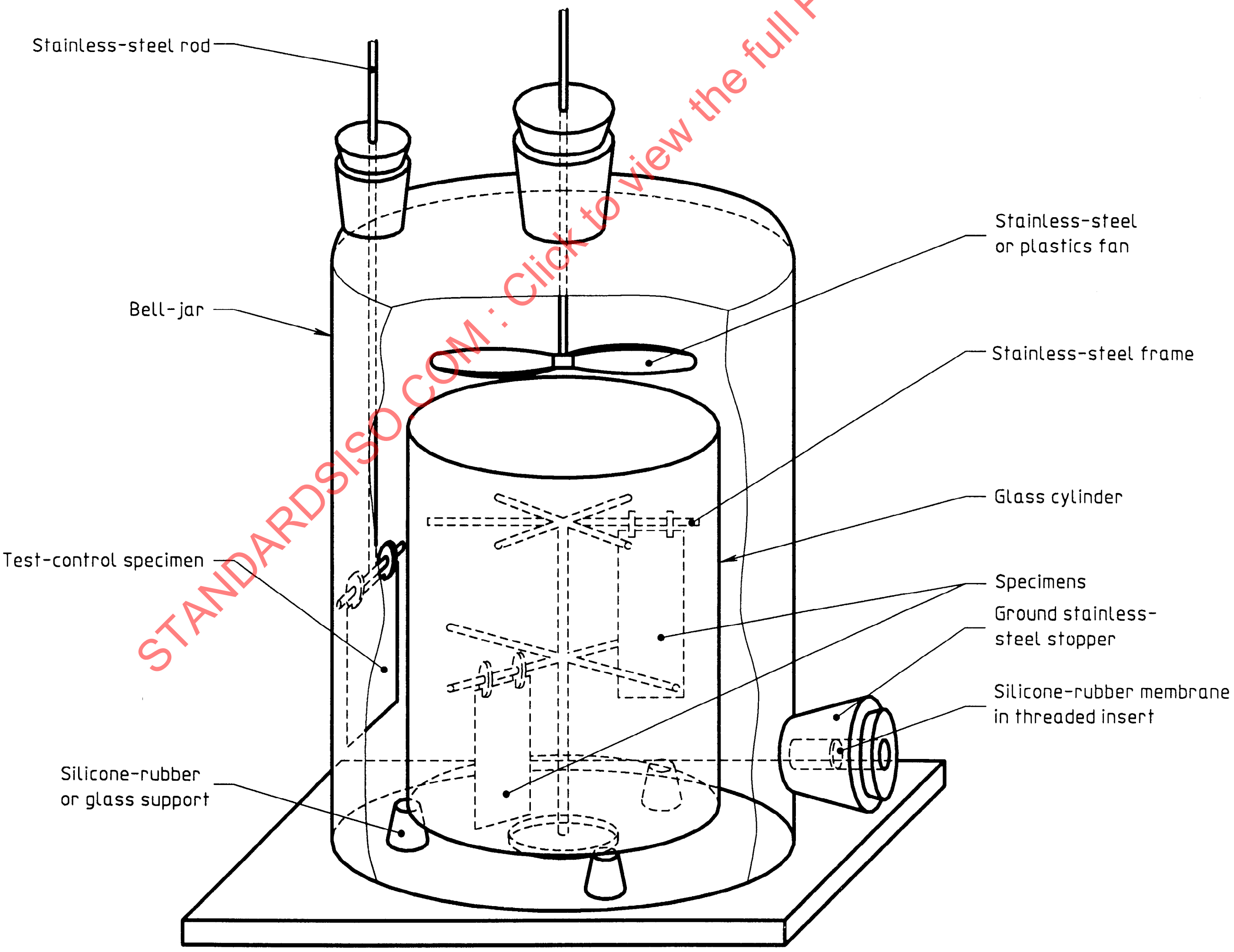

Figure A.1 — Exposure chamber

Dimensions in millimetres

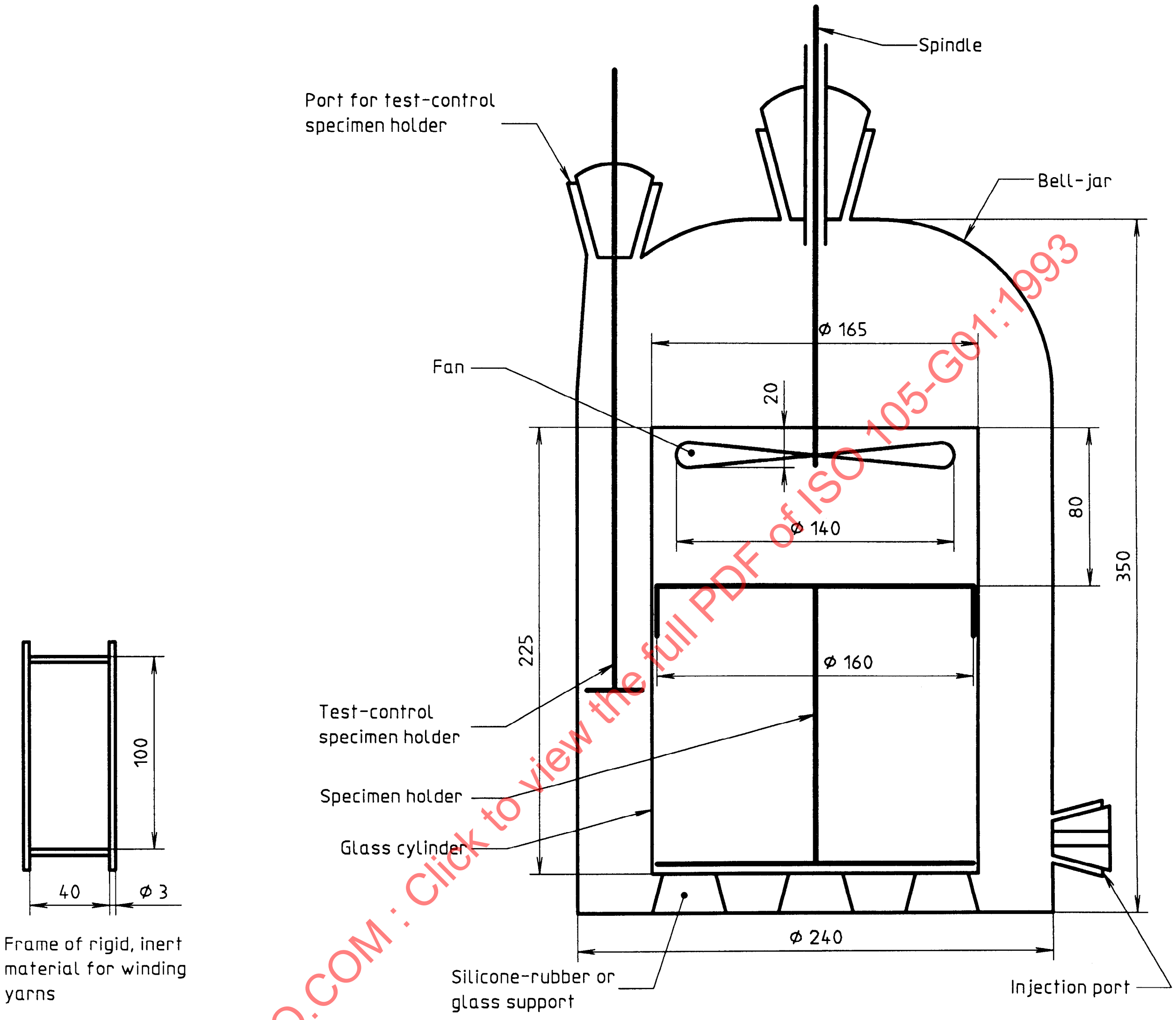

Figure A.2 — Alternative exposure chamber

Annex B
(normative)

Nitric oxide generation apparatus

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.

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 (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 (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 gas 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 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. Repeat this procedure five times to ensure that the nitric oxide is free of air.

B.3 Continuous operation

After the gas reservoir has been filled and emptied five times, fill it 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 shall then be kept open to the atmosphere via cocks 5 and 2.

B.4 Refilling the gas generator

B.4.1 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.

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

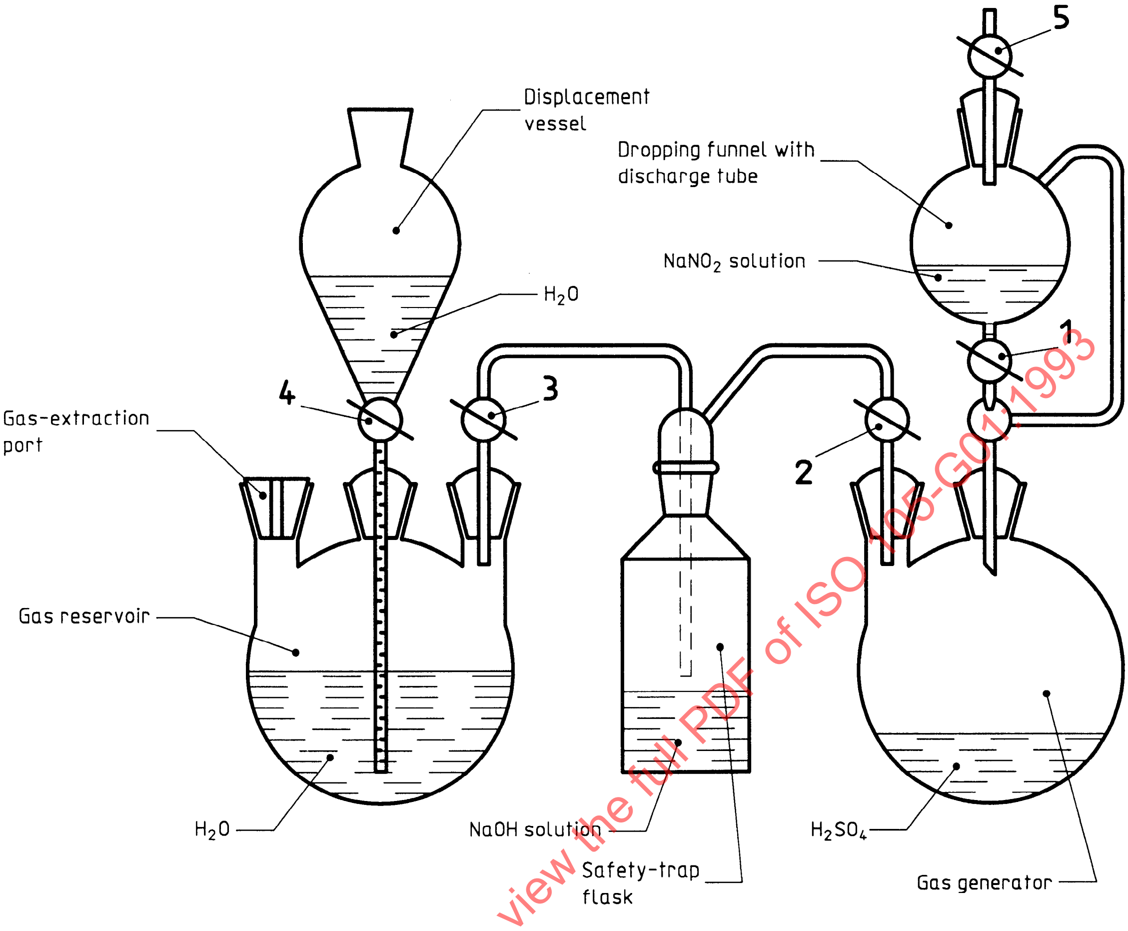

Figure B.1 — Nitric oxide generator