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Standard Test Method for Electrostatic Propensity of Textiles¹

This standard is issued under the fixed designation D 4238; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the determination of the relative electrostatic propensity of fibers, yarns, and fabrics by a corona discharge. This includes the measurement of the maximum charge voltage and the decay half-life.

1.2 This test method is generally not applicable to pile fabrics.

1.3 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. See Section 7 for additional precautionary information.*

2. Referenced Documents

2.1 ASTM Standards:

D 123 Terminology Relating to Textiles²

D 2257 Test Method for Extractable Matter in Textiles³

D 2258 Practice for Sampling Yarn for Testing³

D 3333 Practice for Sampling Man-Made Staple Fibers⁴

2.2 Other Documents:

Method 4046 of Federal Test Method Standard 101B⁵

NFPA No. 56A Standard for the Use of Inhalation Anesthetics⁶

3. Terminology

3.1 Definitions:

3.1.1 *electrostatic decay half-life n —in textiles*, the time in minutes for the maximum voltage induced on the textile to be reduced to one-half of the maximum voltage by the various decay mechanisms: conduction and ionization of the air.

3.1.2 *electrostatic propensity, n —the capacity of a nonconducting material to acquire and hold an electrical charge by induction (via corona discharge) or by triboelectric means (rubbing with another material).*

3.1.3 For definitions of other textile terms used in this standard, refer to Terminology D 123.

4. Summary of Test Method

4.1 A specimen in equilibrium with specified atmospheric conditions of relative humidity and temperature is inductively charged from a corona discharge of a specified voltage and at a specified distance from the specimen. The maximum voltage developed on the specimen is measured (Method 4046 of Federal Test Std. 101B and NFPA 56A Paragraphs 466 on Antistatic Accessories and Testing, and 468 on Textiles). The rate of decay of the charge on the specimen is measured after the charging electrode is discharged.

4.1.1 In practice, a specimen is clamped to a grounded metal disc which is rotated at 1720 rpm. A metal frame, covering the specimen, exposes an area of 32 by 32 mm. Positioned above the path of the rotating sample is a needle electrode to which a direct current potential from ± 0 –10 kv can be applied. Rotation of the sample beneath a detecting electrode provides a means of measuring the charge on the sample. The output is measured on either an oscilloscope or through a direct current recorder. In either case, the resulting attenuated voltage is proportional to the voltage developed on the specimen and is a measure of the charge which is equal to the product of the capacitance and the voltage.

5. Significance and Use

5.1 Test results can be used to predict the electrostatic propensity of fibers, yarns, and fabrics. The test method is useful for quality control, research, and characterization of the static propensity of textiles.

5.2 This test method for testing for electrostatic propensity of textiles is not recommended for acceptance testing of commercial shipments because between-laboratory precision has not been established. In case of dispute, the statistical bias, if any, between the laboratory of the purchaser and the laboratory of the seller should be determined with each comparison being based on the testing of specimens taken from a lot of material of the type being evaluated so as to be as homogeneous as possible and then randomly assigned in equal numbers to each of the laboratories.

6. Apparatus and Materials

6.1 *Static Eliminator*—An ionizing bar incorporating polonium 210 or americium 241 is needed to completely discharge specimen before testing.⁷

6.2 *Conditioning Room or Environmental Chamber*—A chamber capable of housing static testing equipment and of

¹ This method is under the jurisdiction of ASTM Committee D-13 on Textiles and is the direct responsibility of Subcommittee D13.58 on Yarn Test Methods, General.

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² Annual Book of ASTM Standards, Vols 07.01 and 07.02.

³ Annual Book of ASTM Standards, Vol 07.01.

⁴ Annual Book of ASTM Standards, Vol 07.02.

⁵ Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

⁶ Available from National Fire Protection Association, 470 Atlantic Ave., Boston, MA 02210.

⁷ Static eliminator bars are available from Western Static Eliminator Co., 215-219 S. Western Ave., Chicago, IL 60612; Herbert Products Inc., P.O. Box 384, Westburg, NY 11590; and Static, Inc., P. O. Box 414, Lee, MA 01238.

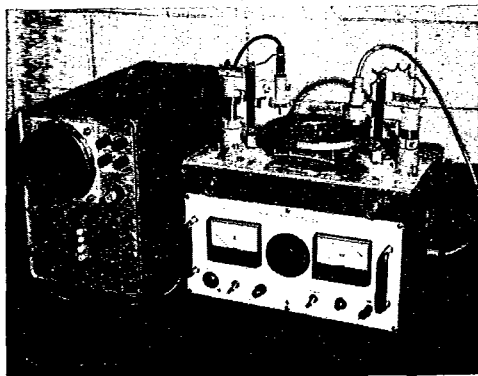
 D 4238


FIG. 1 Instrument for Measuring Static Propensity of Fibers, Yarns, and Fabrics

conditioning specimens prior to testing and providing relative humidities within $\pm 2\%$ between 15 to 65 % and temperature control within $\pm 1^\circ\text{C}$ (2°F) between 10°C (50°F) and 32°C (90°F).

6.3 Static Charging and Measuring Instrument—An instrument capable of applying 0 to $\pm 10\,000$ DC V through a corona discharge and an electrometer voltmeter with a static detecting electrode for measuring the retained charge. The instrument uses a rapidly rotating disk carrying the specimen, with capability of charging at one point and measuring at a point 180° removed (Fig. 1).⁸ The rotating turntable has a spring clamping device for holding the specimen flat and exposing a 32 by 32 mm area of the specimen to the corona discharge.

6.4 An oscilloscope or recorder, capable of displaying the output from the instrument described in 6.3. These devices should have an input resistance of >1 megohm and a sensitivity of 5–10 mV/cm.

6.5 Nonionic detergent, such as Triton X-100.

6.6 Cleaning solvent, trichlorotrifluoroethane.⁹

7. Hazards

7.1 Care must be taken in dealing with the high voltages obtained in this test. It is important that physical contact of any part of the body with the high voltage electrode be avoided, otherwise a severe electrical shock may be encountered.

7.2 Care must be exercised in using the static eliminator bar which contains a radioactive source. Keep exposure to the static eliminator to a minimum.

7.3 The trichlorotrifluoroethane solvent recommended for use in this method should be handled cautiously. While it has relatively low toxicity, breathing the vapors and contact with the skin should be avoided.

8. Sampling

8.1 Lot Sample—Take a lot sample as directed in the applicable materials specification. In the absence of such a

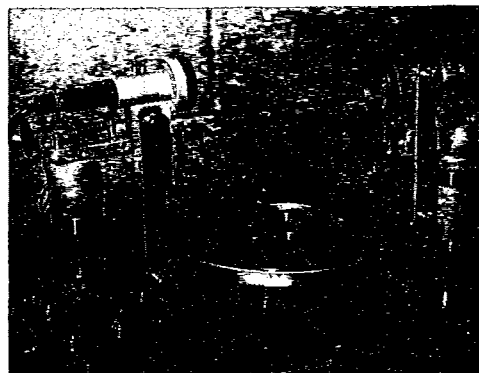


FIG. 2 Specimen Holder, Charging Electrode, and Measuring Electrode

document, select bales of staple for the lot sample as directed in Practice D 3333, and select cases of yarn for the lot sample as directed in Practice D 2258. Select containers of tow, sliver, or top for the lot sample in the same manner as for staple, and select the rolls or pieces of fabrics for the lot sample using the following schedule:

Number of Rolls or Pieces in Lot Inclusive	Number of Rolls or Pieces in Lot Sample
1 to 3	All
4 to 24	4
25 to 50	5
More than 50	10 % of the rolls or pieces or a maximum of 10

8.2 Laboratory Sample:

8.2.1 For staple, take five stratified laboratory samples from each of the bales in the lot sample as directed in Practice D 3333.

8.2.2 For yarn, take one yarn package at random from each case in the lot sample. Wind 100 m skein from each yarn package after removing four traverses of yarn to obtain a fresh surface. Take yarn from beams by agreement between buyer and seller.

8.2.3 From each container of tow, sliver, or top in the lot sample, take the first metre of material from the lead end that has a clean uniform appearance. If the lot sample container consists of multiple packages, take a laboratory sample from only one package randomly from the container.

8.2.4 From each roll or piece of fabric (woven, knit, or nonwoven) selected from the lot sample, cut at least one laboratory sample the full width of the fabric and at least 1 m along the selvage. From each roll or piece of circular knit fabric selected from the lot sample, cut a band at least 300 mm wide.

8.3 Specimen Selection:

8.3.1 Divide the number of specimens to be tested as nearly equally among the laboratory samples from each lot sample container as possible. Determine on a random basis the laboratory sample(s) taken from each lot sample container for which no specimens are to be taken or for which multiple specimens are to be taken.

8.3.2 For printed fabrics, the specimens should be selected to include areas containing all of the dyes and pigments present in the laboratory sample.

8.3.3 Test two specimens from each laboratory sample unit.

⁸ An instrument designed to carry out this test is manufactured by Shishido, Ltd., Tokyo, Japan. The U.S. distributor is Fontaine Industries, Inc., P.O. Box 92612, Long Beach, CA 90809. Technical details of the instrument are described by J. Shashoua, *Journal of Polymer Science*, Vol 33, No. 65 (1958).

⁹ This solvent is available from various suppliers under various tradenames. Freon TF, available from DuPont has been found suitable.