



Association of Textile, Apparel & Materials Professionals

AATCC takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this test method. Users of this test method are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This test method is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reaffirmed or withdrawn. Your comments are invited either for revision of this test method or for additional procedures and should be addressed to the AATCC Technical Center. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing, you should make your views known to Diana A. Wyman, Technical Director, at the address shown below.

This test method is copyrighted by AATCC, PO Box 12215, Research Triangle Park, NC 27709 USA. Individual reprints (single or multiple copies) of this method may be obtained by contacting AATCC at the above address or tel: 919-549-3526; fax: 919-549-8933, or e-mail: orders@aatcc.org.

AATCC License Agreement: This test method is copyrighted by the American Association of Textile Chemists and Colorists (AATCC), PO Box 12215, 1 Davis Drive, Research Triangle Park, NC USA. All rights reserved.

AATCC grants you a license as follows: The right to download one electronic file of this AATCC test method for temporary storage on one computer for purposes of viewing, and/or printing one copy of the AATCC test method for individual use. Neither the electronic file nor the hard copy print may be reproduced in any way. In addition, the electronic file may not be distributed elsewhere over computer networks or otherwise. The hard copy print may only be distributed to other employees for their internal use within your organization.

This test method is not for resale.

Evaluation Procedure for Electrical Resistance of Electronically-Integrated Textiles

Foreword

At the time this evaluation procedure was developed, electronically-integrated textiles (e-textiles) were still a nascent product category. This evaluation procedure is intended to serve mainly as a tool for iterative design and development purposes. It may be used for resistance measurement of any e-textile material or product. As e-textile technology evolves, more specialized methods, or options within this method, may be developed.

1. Purpose and Scope

1.1 This evaluation procedure determines the electrical resistance of e-textiles above 1 Ω . E-textile fabrics or end products with incorporated conductive paths/traces may be evaluated. This method is not for evaluation of yarns or fibers.

1.2 Electrical resistance may be measured as received, or after treatment such as stretch or laundering, etc. The change in resistance due to treatment may also be calculated.

2. Principle

2.1 Electrical resistance of specimens is measured using a digital multimeter and surface probes. Change in resistance is calculated from measurements before and after treatment, if desired.

3. Referenced Documents

3.1 AATCC TM76, Test Method for Electrical Surface Resistivity of Fabrics (see 15.1).

3.2 ASTM D1776, Standard Practice for Conditioning and Testing Textiles (see 15.2).

4. Terminology

4.1 **electronically-integrated textile (e-textile)**, n.—a fabric or textile product with permanently-integrated electrical circuits or parts of electrical circuits.

4.2 **electrical resistance**, n.—a specific textile's ability to reduce electric current flowing through it at a given voltage. Resistance, R , is expressed in units of ohms (Ω).

5. Safety Precautions

NOTE: These safety precautions are for information purposes only. The pre-

cautions are ancillary to the testing procedures and are not intended to be all inclusive. It is the user's responsibility to use safe and proper techniques in handling materials in this test method. Users MUST consult manufacturers for specific details such as safety data sheets and other recommendations. Consult and follow all applicable OSHA standards and rules.

5.1 Follow good laboratory practices. Wear safety glasses in all laboratory areas.

5.2 Follow manufacturer's safety recommendations when operating laboratory testing equipment.

5.3 Use electrical equipment on a non-conductive or grounded surface (see 7.2).

6. Uses and Limitations

6.1 Each conductive path to be measured must be accessible, at least at the two measurement points. Connectors may be used to provide accessibility. The measured specimen should mimic the intended design of the end product, if known.

6.2 Samples with very low resistance may not be measured accurately by the equipment described in this procedure. Refer to multimeter manufacturer for applicable range. Low-resistance samples may require a more sensitive instrument, or a four-point system to eliminate lead resistance.

6.3 Refer to AATCC TM76 for samples having a resistance higher than $10^5 \Omega$.

7. Apparatus and Materials (see 15.3).

7.1 Conditioning facilities and racks with pull-out, perforated shelves for laying specimens flat (see 15.1).

7.2 Flat workbench with grounded electronic static dissipation (ESD) mat. The surface should be at least as large as the specimen.

7.3 Indelible ink marking pen (see 15.1) or needle and sewing thread, for making benchmarks.

7.4 Digital multimeter, also known as DMM or volt-ohm-meter, VOM. Resolution to 0.1 Ω and 0.9% accuracy. Probes should be appropriate to the test material. Multimeter and probes should be consistent with those used to test other electrical components of the end product.

7.5 Tape or rule marked in millimeters.

8. Test Specimens

8.1 Each conductive path (or section of a path) is considered a specimen and should mimic the intended design of the end product. Measure at least 3 specimens.

8.1.1 Select specimens that can be arranged to lie flat on the measurement surface with no tension and no risk of a short circuit.

8.1.2 For convenience, straight specimens, 150-300 mm in length, are recommended for development testing.

8.1.3 Specimens from end products will depend upon product design. Complete conductive pathway should be tested.

8.2 Select identical specimens from at least 3 swatches or end products.

8.2.1 Size and shape of swatches or end products is not critical to this evaluation procedure.

8.2.2 If measuring resistance after treatment (stretch, laundering, etc.), refer to the appropriate treatment test method or procedure for swatch dimensions.

8.3 Handle specimens with care to avoid contamination, in particular, salts or moisture from human hands, which may affect resistance measurements.

9. Conditioning

9.1 Prior to marking, condition test specimens as directed in ASTM D1776. (Use conditions indicated in Table 1 for Textiles, general. Estimate conditioning time as indicated in Table 2 for the appropriate fiber content.) Lay each swatch or product, separately, on a screen or perforated shelf of a conditioning/drying rack.

9.2 Mark the ends of each specimen. If sewing thread is used, ensure that needle holes do not interrupt the circuit.

9.2.1 If the conductive path to be measured connects to an electronic system, the mark should be made at the point where the path in the textile connects to the electronic system.

9.3 If fraying of swatches is expected in treatment, edges may be pinked or serged.

10. Procedure

10.1 Arrange the first specimen on flat, non-conductive surface for measurements.

10.2 Set multimeter to resistance measurement mode, in units of ohms.

10.3 Place the positive and negative