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Standard Guide for The Use of Standard Test Methods and Practices for Evaluating Antibacterial Activity on Textiles¹

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1. Scope

1.1 This guide provides users with an index of procedures in the form of test methods, practices, and related international documents that are currently used in the textile industry for determining antibacterial properties of antimicrobial treated textile articles. This guide is not considered as all-inclusive for antimicrobial testing procedures related to textiles.

1.2 This guide identifies some existing ASTM and other industry standard test methods applicable for testing the antibacterial performance on textiles and discusses options within each method that have been used to address specific end-use performance expectations.

1.3 This guide is intended to assist testing facilities in determining which test methods are appropriate for which treated articles based on type of antimicrobial active involved (diffusible versus non-diffusible), nature of test fabric, and expected end use.

1.4 The test methods indicated in this guide should be performed only by those trained in microbiological techniques, are familiar with textile antimicrobial agents and with the end use exposures of the antimicrobial treated textile material.

1.5 *This standard does not purport to address all of the safety concerns, if any, 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.*

2. Referenced Documents

2.1 ASTM Standards:²

E2149 Test Method for Determining the Antimicrobial Activity of Antimicrobial Agents Under Dynamic Contact Conditions

E2180 Test Method for Determining the Activity of Incorporated Antimicrobial Agent(s) In Polymeric or Hydrophobic Materials

E2722 Test Method for Using Seeded-Agar for the Screening Assessment of Antimicrobial Activity in Fabric and Air Filter Media

E2756 Terminology Relating to Antimicrobial and Antiviral Agents

2.2 AATCC Standards:³

AATCC Test Method 90: Antibacterial Activity Assessment of Textile Materials: Agar Plate Method. American Association of Textile Chemists and Colorists, RTP, NC

AATCC Test Method 100: Antibacterial Finishes on Fabrics, Evaluation of. American Association of Textile Chemists and Colorists, RTP, NC

AATCC Test Method 147: Antibacterial Activity Assessment of Textile Materials: Parallel Streak Method. American Association of Textile Chemists and Colorists, RTP, NC

2.3 ISO Standards:⁴

ISO 20743 Textiles – Determination of Antibacterial Activity of Antibacterial Finished Products

ISO 22196 Plastics – Measurement of Antibacterial Activity on Plastics Surfaces

2.4 JIS Standards:⁵

JIS L 1902 Testing for Antibacterial Activity and Efficacy on Textile Products

JIS Z 2801 Antimicrobial Products – Test for Antimicrobial Activity and Efficacy

2.5 Other Standards:

SNV 195920 Examination of the Antimicrobial Effect of Impregnated Textiles by the Agar Diffusion Test⁴

IBRG TEX13/005/1.0 Quantitative Method for Evaluating Bactericidal Activity of Textiles and Porous Materials and Articles

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from AATCC 1 Davis Dr Research Triangle Park, NC 27709-2215 USA. <http://www.aatcc.org/>

⁴ Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, <http://www.iso.org>.

⁵ Available from Japanese Industrial Standards Committee (JIS) 1-3-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-8901, JAPAN. <http://www.jisc.go.jp>

3. Terminology

3.1 For definitions of terms used in this Guide see Terminology [E2756](#).

4. Significance and Use

4.1 Antimicrobial agents are routinely used for treating textile materials for the reduction of biodeterioration and bacterial odor generation. Furthermore, textiles are treated to prevent or limit microbial cross-contamination in healthcare settings.

4.2 Antimicrobial agents used in textiles will vary with regard to their broad-spectrum effectiveness, biostatic/biocidal properties, and binding properties in or on particular substrates. When selecting antibacterial test methods as the sole means to predict end use behavior it is critical to understand the intended end use conditions of the treated articles.

4.3 Textile materials differ with regard to the knit/weave, fabric composition, and added functional feature (for example, water repellent, flame retardant, softener, whitener). Each of these factors may alter test results within a given method.

4.4 The test methods indicated below differ mainly in the procedure for inoculating samples, levels of nutrients in the bacterial challenge, organisms used, and exposure times.

4.5 This guide is intended to review each commonly used industry standard test method for its applicability with an understanding of each of the factors listed above. Further, it is the intention of this guide to indicate commonly used and generally accepted modifications of each method when measuring specific end-use functionalities.

4.6 These test methods are not, in themselves, absolute indicators of real life performance. Such performance criteria are developed based on a series of antimicrobial and analytical test methods in addition to simulated real life use studies. All antimicrobial agents used for the treatment of textiles should be compliant with local regulatory agencies and should be deemed safe for the proposed end-use and claims.

5. Qualitative Antimicrobial Test Methods for Textiles

5.1 **AATCC TM 147**—is a qualitative test to measure antibacterial activity of diffusible antimicrobial agents on treated textile material.

5.1.1 *Significance and Use*—The objective is to detect bacteriostatic activity on textile materials. The method is useful for obtaining a rough estimate of activity in that the growth of the inoculum organism decreases from one end of each streak to the other and from one streak to the next resulting in increasing degrees of sensitivity. The size of the zone of inhibition and the narrowing of the streaks caused by the presence of the antibacterial agent permit an estimate of the residual antibacterial activity after multiple washes.

5.1.2 Typical industry modifications include the use of multiple microbial organisms on a single plate. While the test method was developed to obtain a rough estimate of activity of a treated article by systematically decreasing the dose of organism across the surface of an agar plate, so too can this method be used as a fast determination of broad spectrum

activity if multiple organisms are used. In many cases, four organisms are streaked lengthwise per agar plate (*Escherichia coli*, *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Candida albicans*) with a test fabric strip placed at 90 degrees on the agar surface across streaks if multiple organisms are used. In many cases, four organisms are streaked lengthwise per agar plate (*Escherichia coli*, *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Candida albicans*) with a test fabric strip placed at 90 degrees on the agar surface across streaks.

5.1.3 *Evaluation of the test includes determination of a Zone of Inhibition (ZOI)*—the width of the inhibition zone away from the treated substrate (in millimetres) or an evaluation of the level of growth underneath the test substrate. Care must be taken when evaluating growth directly underneath the sample. Some materials, including plastics and films, can make such intimate contact with the agar surface that no microbial growth is observed underneath the sample. It is recommended to compare results of treated samples to an untreated sample composed of the same type of material to avoid false positives.

5.1.4 Lack of a ZOI does not necessarily indicate that the treated material does not contain an antimicrobial agent. In some cases, the nutrients available in agar medium or the agar matrix itself can deactivate the antimicrobial agent, leading to false-negative results. Alternative methods such as the Test Method [E2149](#) or the AATCC 100 with low to no nutrient inoculum conditions can better define activity for those antimicrobials that are bound by nutrients or agar.

5.1.5 Growth directly under a test fabric does not necessarily indicate that the treated material does not contain an antimicrobial agent. If direct contact with the treated textile is required, bacteria may grow directly under the treated substrate without the needed intimate contact with the treated substrate. Alternative quantitative methods indicated below may be more appropriate for antimicrobial agents that are not diffusible into the surrounding medium.

5.1.6 Many test methods incorporate the agar based methodology for determining ZOI activity. AATCC TM 90, SNV 195920 and JIS L1902 are examples of international standards that contain aspects of measuring zone of inhibition in an agar medium.

5.1.7 This test method can be a good bioassay method for detecting antimicrobial activity compared to untreated controls and is appropriate for use in quality control test programs.

5.2 **Test Method E2722**—is designed to evaluate qualitatively the presence of antibacterial and antifungal activity in or on fabrics or air filter media.

5.2.1 *Significance and Use*—This test method provides for rapid screening of antimicrobial treatments located in or on fabrics and air filter media. The method simulates actual use conditions that may occur on fabrics and provides a means to screen for activity and durability of an antimicrobial treatment under conditions of organic loading.

5.2.2 Typical industry modifications include the use of multiple microbial organisms.

5.2.3 This test method provides for a simultaneous assessment of multiple fabric components for antimicrobial activity, for example, fabric, component fibers with polymer incorporated treatments, and back coating if present.