Designation: D 6650 – 01

Standard Test Method for Determining the Dynamic Wiping Efficiency, Wet Particle Removal Ability, and Fabric Particle Contribution of Nonwoven Fabrics Used in Cleanrooms[1]

This standard is issued under the fixed designation D 6650; 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 dynamic wiping efficiency, wet particle removal ability and fabric particle contribution of nonwoven fabrics.

1.2 This test method applies to all nonwoven fabrics used in cleanrooms. For more information see Journal of the IEST[2], [3].

NOTE 1—For dynamic wiping efficiency in non-cleanrooms, refer to Test Method D 6702 Standard Test Method for Determining the Dynamic Wiping Efficiency of Nonwoven Fabrics Not Used in Cleanrooms.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as the standard. Within the text, the inch-pound units are shown in parentheses. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

1.4 *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:*

D 123 Terminology Relating to Textiles[4]

D 6702 Test Method for Determining the Dynamic Wiping Efficiency of Nonwoven Fabrics Not Used in Cleanrooms[5]

2.2 *Federal Standard:*

209E, "Airborne Particulate Cleanliness Classes in Cleanrooms and Clean Zones," (September 11, 1992)[6]

3. Terminology

3.1 *Definitions:*

3.1.1 *cleanroom*, *n*—a room in which the concentration of airborne particles is controlled, and which is constructed and used in a manner to minimize the introduction, generation, and retention of particles inside the room.

3.1.1.1 *Discussion*—In addition to particles, other relevant parameters, such as temperature, humidity, and pressure, are controlled as required. The so-called Class of a cleanroom is defined in documents including but not limited to. Federal Standard 209E as the concentration per unit volume of particles of a designated size. The various systems for such classification lie beyond the scope of this document.

3.1.2 *dynamic wiping efficiency*, *n*—in textile fabrics, the ability of a fabric to remove water, or other liquids, from a surface, usually for spill removal.

3.1.2.1 *Discussion*—The ability of a fabric to hold liquid is largely a function of the composition and construction of the fabric. A naturally sorptive fabric made of or with hydrophilic components will ABSORB liquid (usually water) while those made of hydrophobic materials will ADSORB liquid (typically water) between the interstices of the fibers composing the fabric. In many cases, both absorption and adsorption take place.

3.1.3 *fabric particle contribution*, *n*—textile fabrics, the number of particles contributed by a fabric used for spill removal without the intentional addition of any foreign particles.

3.1.4 *wet particle removal ability*, *n*—in textile fabrics, the ability of a fabric to I remove liquid contaminated with small particles of known size and quantity from a surface, usually for spill removal.

3.2 For definitions of terms used in this test method refer to Terminology D 123.

4. Summary of Test Method

4.1 *Dynamic Wiping Efficiency*—A quarter-folded fabric swatch is clipped to the underside of a 1-kg sled and pulled through a known challenge of liquid, usually water, placed on a flat surface directly in front of a wiper fabric and sled. The percent of liquid removed from the surface is determined gravimetrically as the dynamic wiping efficiency.

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[1] This test method is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.64 on Nonwovens.

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[2] Oathout, J. M., "Determining the Dynamic Efficiency of Cleanroom Wipers for Removal of Liquids and Particles from Surfaces," *Journal of the IEST*, 62 (3), 17-26, May/June 1999.

[3] "Evaluating Wiping Materials Used in Cleanrooms and Other controlled Environments," IEST-RP-CC004.2, Institute of Environmental Science and Technology, 940 East Northeast Highway, Mount Prospect, IL 60056 (1992).

[4] *Annual Book of ASTM Standards*, Vol 07.01.

[5] *Annual Book of ASTM Standards*, Vol 07.02.

[6] Available from Institute of Environmental Sciences and Technology, 940 East Northwest Highway, Mount Prospect, IL 60056.

4.2 *Wet Particle Removal Ability*—The dynamic wiping efficiency test is performed as summarized in 4.1 except the liquid challenge is salted with a known quantity and size of contaminants, and the number of residual contaminants left after wiping from a surface are counted with a discrete-particle counter as wet particle removal ability (WPRA).

4.3 *Fabric Particle Contribution*—The dynamic wiping efficiency test is performed as summarized in 4.2 except dynamic wiping efficiency is carried out without any addition of particles, and the particles left on the surface from the wiping material after wiping are counted with a discrete-particle counter. These particles above a previously determined blank are counted as the fabric particle contribution.

5. Significance and Use

5.1 This test method can be used for acceptance testing of commercial shipments but comparisons should be made with caution because information on estimates of between-laboratory precision is limited as noted in the precision and bias section of this test method.

5.1.1 If there are differences of practical significance between reported test results for two laboratories (or more), comparative tests should be performed to determine if there is a statistical bias between them, using competent statistical assistance. As a minimum, samples used for such comparative tests should be as homogeneous as possible, drawn from the same lot of material as the samples that resulted in disparate results during initial testing, and randomly assigned in equal numbers to each laboratory. Other fabrics with established test values may also be used for these comparative tests. The test results from the laboratories involved should be compared using a statistical test for unpaired data, at a probability level chosen prior to the testing series. If bias is found, either its cause must be found and corrected, or future test results must be adjusted in consideration of the known bias.

5.2 This test method depends on the ability to accurately place a known mass/volume of liquid and number of particles on a surface, so that an accurate mass of liquid adsorbed, number of particles contributed by a wiping fabric, and the number of particles contributed by a known contaminant to the liquid may be determined.

5.3 This test method is useful to select fabrics with superior cleaning and drying properties that can minimize the costs for spill removal. It can also be used to research fabrics for improved spill removal and for production control.

5.4 It is beneficial to perform the dynamic wiping efficiency test in unison with the wet particle removal ability test. This allows for a more precise correlation of these variables.

6. Apparatus and Materials[7]

6.1 *Dynamic Wiping Efficiency Test Apparatus*, consisting of a polyester string attached to two stainless steel screws on a stainless steel sled (6.1.1), forming a yoke, and with a second polyester string, approximately 1.5 m (5 ft) long having one end of attached at the midpoint of the yoke and the other end free. (See Fig. 1)

6.1.1 *Sled*, # 304 stainless steel, 1 kg ± 10 g, 117 × mm × 117 mm base, 9.53 mm thick (4.63 in. by 4.63 in. base, 0.375 in. thick), with 1 mm (0.05 in.) tolerances; a curved leading edge, 13 ± 1 mm (0.50 in. ± 0.05 in.) radius on the base of the sled forms a lip to which the quarter-folded sample is attached using a spring-loaded clip. Two stainless steel screws are affixed to either outboard edge of the sled in the leading curved edge. (See Fig. 2)

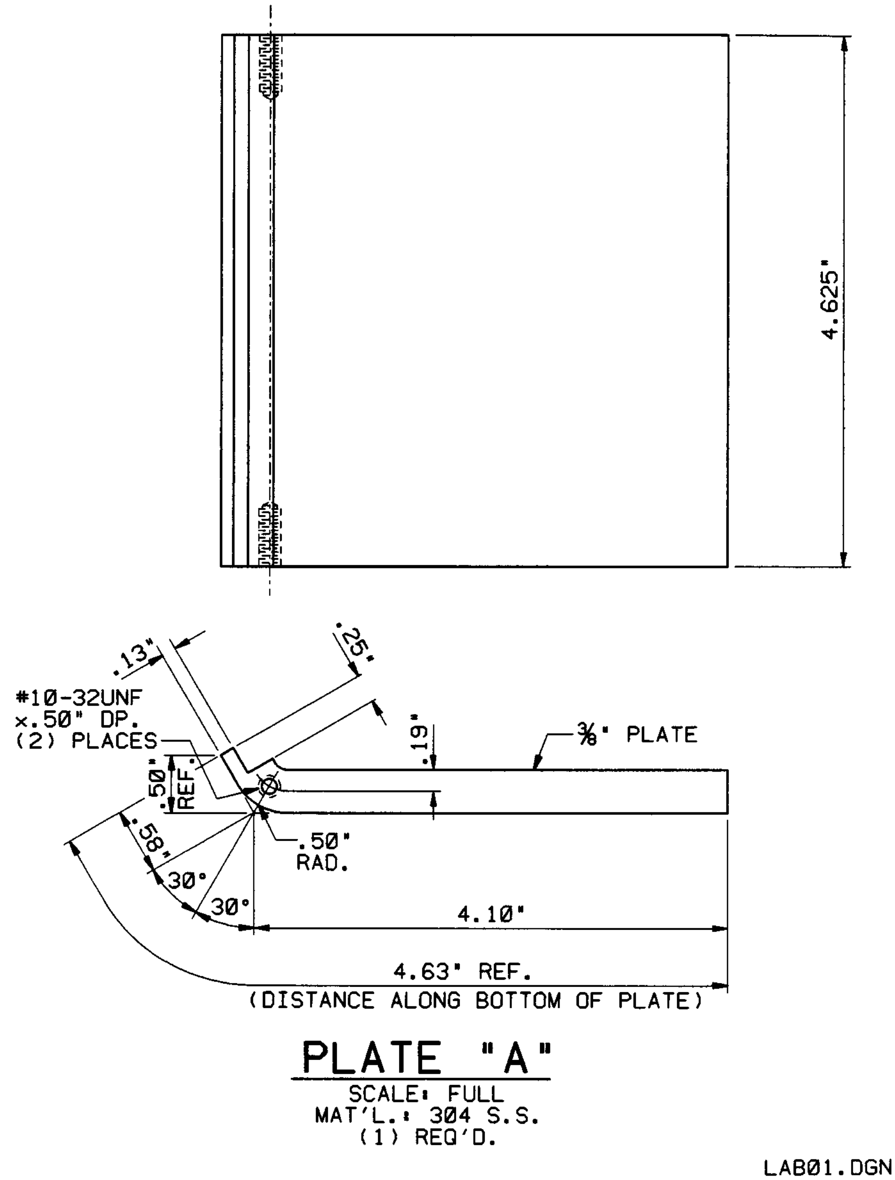
6.1.1.1 If necessary, drilling into the upper surface of the sled or lead inserts can be utilized to meet the sled weight requirement.

6.2 *Balance*, top loading, shielded, at least 0.01 g readability.

6.3 *Dispenser*, digital bottletop burette, for reproducible and accurate delivery of liquid volumes, Brinkmann Bottletop Buret, Model 25, or equivalent.

[7] Apparatus and materials are commercially available, except for 6.1.1 which requires fabrication.

FIG. 1 Illustration of Apparatus to Determine Dynamic Wiping Efficiency, Wet Particle Removal Ability, and Fabric Particle Contribution



(For SI units in millimeters, multiply inches by 25.4)

FIG. 2 Drawing of Sled

6.4 *Cleanroom Water System*, capable of providing clean water as described in 6.5.1.

6.5 *Liquid*, usually water at least distilled grade, or other liquid when specified.

6.5.1 For wet particle removal ability and fabric particle contribution, when using water, the water must have fewer than 10 particles/mL, ≥ 0.5 µm diameter as obtained from a Millipore system consisting of a reverse osmosis unit (Milli-RO 10 Plus), an arrangement of filters and ion exchange beds (Milli-Q UF Plus), and a 0.2 µm filter (Millipak 40) at the point of use, or equivalent.

6.6 *Tray*, stainless steel, with inside dimensions of 45 cm × 28 cm × 7 cm (17.7 in. × 11 in. × 2.75 in.).

6.7 *Mono-Disperse Spheres*, poly(styrene)-latex, 1.59 µm diameter at a concentration of 3×10^8/mL, Duke Scientific Surf Cal Scanner, PD 1600, or equivalent.

6.8 *Syringe*, microliter, Hamilton, 50 pL, Model 705RN, point style 3 (blunt end for accurate delivery), or equivalent.

6.9 *Particle Counter*, discrete-particle counter with the ability to enumerate particles of 1.0-2.0 µm diameter, PMS Liquilaz S05, or equivalent.

6.10 *Cleanbench*, laminar flow, providing cleanroom quality air of Class M2.5 or better as described in Federal Standard 209E.

6.11 *Cleanroom Gloves*, latex, unpowdered.

6.12 *Die Cutter*, to prepare 229 by 229 mm (9.00 by 9.00 in.) specimens with tolerances of 1 mm (0.05 in.).

7. Sampling and Test Specimens

7.1 *Primary Sampling Unit*—Consider rolls, bolts, or prepackaged pieces of textile fabric to be the primary sampling unit, as applicable.