Designation: ~~F24 – 09 (Reapproved 2015)~~ F24 – 20

Standard Test Method for Measuring and Counting Particulate Contamination on Surfaces[1]

This standard is issued under the fixed designation F24; 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 size distribution analysis of particulate contamination, ~~5 µm~~ 5 µm or greater in size, either on, or washed from, the surface of small electron-device components. A maximum variation of two to one (±33 % of the average of two runs) should be expected for replicate counts on the same sample.

1.2 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Terminology

2.1 *Definitions:*

2.1.1 *fiber, n*—a particle longer than 100 µm and with a length to width ratio of greater than 10:1.

2.1.2 *particulate ~~contaminant—~~contaminant, n*—a discrete quantity of matter that is either foreign to the surface on which it rests or may be washed from the surface on which it rests by the ultrasonic energy procedure herein described.

2.1.3 *particle ~~size—~~size, n*—the maximum dimension of the particle.

~~2.1.3 *fiber*—a particle longer than 100 µm and with a length to width ratio of greater than 10:1.~~

2.1.4 *planar ~~surface—~~surface, n*—a surface that does not move out of the depth of field of the microscope when the area to be observed is traversed under the highest magnification to be used.

3. Summary of Method

3.1 This test method comprises two procedures for preparing specimens for microscopical analysis: one for adhered particles on planar surfaces and the second for particulate contamination removed from irregular surfaces.

3.2 A single optical analysis procedure is presented for particle enumeration in stated size ranges.

3.3 For planar surfaces, the component is mounted on a suitable flat support and mounted on the microscope stage. For irregular surface components, the contamination is removed by subjecting the component to an ultrasonic cavitation field while immersed in water containing a detergent.

3.4 The contamination is subsequently transferred to a membrane filter disk by filtration and then examined microscopically.

3.5 Microscopical analysis of the contaminant is conducted at two magnifications using a gating measurement technique with oblique incident lighting.

3.6 Particles are counted in three size ranges: ~~>100 µm,~~ >100 µm, 25 to ~~100 µm,~~ 100 µm, 5 to ~~25 µm,~~ 25 µm, and fibers.

3.7 For low-contamination levels on irregularly shaped components, a procedure for running a blank is described.

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[1] This test method is under the jurisdiction of ASTM Committee E21 on Space Simulation and Applications of Space Technology and is the direct responsibility of Subcommittee E21.05 on Contamination.

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3.8 The method requires strict adherence to the procedures for cleaning apparatus.

4. Apparatus

4.1 *Microscope,* with mechanical stage, approximately 45 and 100×. For 100× magnification, the recommended objective is 10 to 12× (but a minimum of 6×) with a numerical aperture of 0.15 minimum. The optimum equipment is a binocular microscope with a micrometer stage. A stereomicroscope should not be used in this procedure.

4.2 *Ocular ~~Micrometer,~~Micrometer.* ~~B & L 31–16–10.~~[2]

4.3 *Stage Micrometer,* ~~B & L 31–16–99,~~having ~~0.1-~~0.1 to ~~0.01-mm~~0.01 mm calibration.

4.4 *Light Source*—An external incandescent high-intensity, 6-V, 5-A source with transformer.

4.5 *Microscope Slides*—Glass slides 50 by 75 mm.

4.6 *Plastic Film*—Wash with membrane-filtered isopropyl alcohol.

4.7 *Solvent Filtering Dispenser.*

4.8 *Membrane Filter Holder,* having ~~47-mm~~47 mm diameter and heat-resistant glass base.

4.9 *Filter Flask,* 1 L.

4.10 *Membrane Filters,* having ~~47-mm~~47 mm diameter, ~~0.45-µm~~0.45 µm pore size, black, grid marked.

4.11 *Vacuum Source*—Pump or aspirator (tap recommended).

4.12 *Flat Forceps,* with unserrated tips.

4.13 *Plastic Petri Dishes.*

4.14 *Ultrasonic Energy Cleaning Apparatus,* having ~~2-L~~2 L minimum capacity (see Appendix X1).

4.15 *Beaker,* ~~500-mL,~~500 mL, chemical-resistant glass.

4.16 *Double-Faced Pressure-Sensitive Tape.*

5. Reagents

5.1 *Isopropyl Alcohol,* ACS reagent grade, membrane-filtered.

5.2 *Nonionic Liquid Wetting Agent,* membrane-filtered.

5.3 *Water*—Deionized or distilled water, membrane-filtered.

5.4 Membrane-filtered reagents shall be stored in bottles precleaned as described in 7.2.1 or by use of Swinney hypodermic filters in a Guth bottle. A procedure for control analysis of reagent cleanliness is described in Appendix X2.

6. Determination of Background Counts

6.1 Prepare a blank by following steps 7.2.1 – 7.2.16, without introduction of the part, for the purpose of determining background counts.

6.2 Background counts are to be subtracted from the final counts when parts are used.

6.3 If excessively high background counts are obtained, cleaning procedures and handling shall be reexamined before proceeding.

7. Preparation of Test Specimens

7.1 *For Planar Surfaces:*

7.1.1 Prepare a ~~50-~~50 by ~~75-mm~~75 mm microscope slide by adhering to it a ~~25-~~25 by ~~50-mm~~50 mm strip of double-faced masking tape.

7.1.2 With clean forceps, carefully remove the component to be tested from its container and place it on the tape.

7.1.3 Perform a particle count in accordance with Section 8.

7.2 *For Irregular Surfaces:*

7.2.1 Ultrasonically clean all glassware, storage containers, and filter holders in hot water containing a detergent.

7.2.2 After washing, rinse the equipment with membrane-filtered water and membrane-filtered isopropyl alcohol and drain dry.

7.2.3 For use at low-contamination levels, check the cleanness of the equipment by conducting successive blank analyses.

NOTE 1—Wash bottles for providing membrane-filtered water and solvents may be constructed by attaching a Swinney adapter containing a ~~0.8-µm~~0.8 µm membrane filter to the base of the outlet tube of a Guth wash bottle.

7.2.4 Carefully remove the component to be analyzed from its container with clean forceps and place it in a clean ~~500-mL~~500 mL beaker containing ~~200 mL~~ 200 mL of membrane-filtered distilled water to which 0.1 % by volume of a nonionic wetting agent has been added.