Designation: F 318 – 06

Standard Practice for Sampling Airborne Particulate Contamination in Cleanrooms for Handling Aerospace Fluids[1]

This standard is issued under the fixed designation F 318; 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 practice covers a procedure for sampling airborne particulate matter larger than 5 µm in size. The method is designed to be used in specific areas, commonly called cleanrooms in the aerospace industry, where aerospace fluids are handled.

NOTE 1—Practice F 50 is an alternative procedure.

1.2 *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]

D 1193 Specification for Reagent Water

D 1836 Specification for Commercial Hexanes

D 2021 Specification for Neutral Detergent, 40 Percent Alkylbenzene Sulfonate Type[3]

E 2042 Practice for Cleaning and Maintaining Controlled Areas and Clean Rooms

F 25 Test Method for Sizing and Counting Airborne Particulate Contamination in Clean Rooms and Other Dust-Controlled Areas Designed for Electronic and Similar Applications

F 50 Practice for Continuous Sizing and Counting of Airborne Particles in Dust-Controlled Areas and Clean Rooms Using Instruments Capable of Detecting Single Sub-Micrometre and Larger Particles

F 312 Test Methods for Microscopical Sizing and Counting Particles from Aerospace Fluids on Membrane Filters

3. Terminology

3.1 *Definitions:*

3.1.1 *cleanroom*—an area in which the temperature, humidity, and the airborne particulate contamination are controlled as required.

3.1.2 *uninterrupted airflow pattern*—the pattern of airflow that exists in a given area, when no personnel or equipment are present to interrupt the airflow.

4. Summary of Practice

4.1 This practice is based on the impingement of particles on a filter membrane using a vacuum technique. The number of air samples required in a given area will be based upon the geometric floor area, the disturbance to the uninterrupted airflow pattern, and the room volume. See also Practice E 2042 and Test Method F 25.

5. Apparatus

5.1 *Filter Holder*—Aerosol open-type for a filter membrane.

5.2 *Vacuum Pump or Aspirator*—Minimum capacity 25 in. (635 mm) Hg at 10 standard L/min.

5.3 *Flowmeter*—Orifice-type, rotameter-type or equivalent positive flow-indicating device, capable of being calibrated to a ±5 % flow accuracy under sample area ambient conditions. Calibration must be at a given vacuum using a given diameter and length of line from the vacuum source to the filter holder containing a filter membrane of the same pore size as used in the test sample.

5.4 *Membrane Filter*—A nominal overall diameter with grid lines, in dimensional accord with the filter holder, may be used. The pore size should be selected with regard to pertinent particle ranges and a specified flow rate across an effective

[1] This practice 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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[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] Withdrawn.

sampling area of 1000 mm^2 ± 5 %. Color contrast is recommended to aid in identification of particulate matter.

5.5 *Forceps*—Stainless steel, nonmagnetic, unserrated tips.

5.6 *Microscope and Associated Apparatus*—For a description of a suitable apparatus, refer to Test Methods F 312.

5.7 *Wash Bottle*, fitted with an in-line filtration capability.

6. Reagents and Materials

6.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available.[4] Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

6.2 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean reagent water conforming to Specification D 1193.

6.3 *Detergent*, free-rinsing. Material conforming to Specification D 2021 is suitable.

6.4 *Isopropyl Alcohol*, acetone-free.[5]

6.5 *Solvent*, selected for safety or other reasons. The following solvents may be used:

6.5.1 *Petroleum Ether*, having a boiling range of from 30 to 60°C.

6.5.2 *Commercial Hexanes*, conforming to Specification D 1836.

7. Sampling

7.1 The sample shall be collected by impinging airborne particles on a filter membrane over 1000 mm^2 of effective filtering area ±5 %. The surface of the filter membrane can be used in a vertical-upward or horizontal position facing an air-pattern current.

7.2 The standard sample for this practice shall be 10 ft^3(283 L) ±5 %.

7.3 The sample shall be taken at a height 30 to 40 in. (762 to 1016 mm) above the floor unless the special consideration described in 7.5 applies.

7.4 For every area a minimum of one sample shall be taken, considering the following conditions:

7.4.1 One or more samples shall be required for each 1000 ft^2 of area, using the geometric floor area.

7.4.2 Interruptions to the normal airflow pattern are caused by personnel and equipment during work operations. The area should remain in a condition without disturbance for 30 min prior to any determination of the uninterrupted airflow pattern.

7.4.3 Room volume of high bay areas should be evaluated to increase the number of required samples when high bay is part of normal operations in accordance with 7.5.

7.5 Special consideration of all permanent and temporary sensitive work areas within the cleanroom, such as laminar flow stations for critical assembly, will require air samples as needed.

8. Preparation of Apparatus

8.1 Prior to sampling, clean the filter holder and forceps by washing in a free-rinsing detergent, ketone-free isopropyl alcohol, a petroleum ether (30 to 60°C boiling range), or trichloromonofluoromethane.

8.2 Maintain the area used for loading the filter holder and background counting in a condition of cleanliness equal to or superior to the area being sampled.

8.3 Personnel performing loading, background count, or unloading after sample, shall be attired in clothing consistent with the cleanliness requirements of the atmosphere being sampled.

8.4 All microscope slides or petri dishes shall be cleaned with refrigerant or equivalent solvent before being used to preserve filter membranes prior to or after sample. Lens tissue is *not* acceptable as a cleaning material.

8.5 Hazardous materials employed in this practice shall be handled with specific precautions.

8.6 All cleaning efforts shall achieve a contamination level consistent with the standard of the air particle sample being taken.

8.7 All related sampling or evaluation apparatus, or both, shall be maintained at a cleanliness level consistent with the requirements of the area being sampled.

8.8 A blank analysis count shall be required on each filter membrane. Prior to use for sample test after blank analysis, place the filter membrane in a clean petri dish with cover until needed for the sample.

9. Procedure

9.1 Connect the vacuum source to a clean filter holder inserting a flowmeter so as to verify the flow rate through the aerosol filter holder containing a filter membrane of the pore size required by the sample. The vacuum source should be located outside the cleanroom area or suitably enclosed and vented outside the cleanroom area.

9.2 Using clean forceps, carefully remove the filter membrane from its petri dish and place grid side up on the screen support of the filter holder. Secure the filter membrane in place.

9.3 Locate the filter holder 30 to 40 in. (762 to 1016 mm) from the floor level in a vertical upward or horizontal attitude depending on the airflow pattern.

9.4 Adjust the vacuum to produce a flow rate that will assure a sample volume as given in 7.2, such as 10 L/min for a period of 28.3 min.

9.5 Remove the filter membrane from the filter holder with forceps and place between clean microscope slides or in a clean petri dish with a cover.

9.6 Place the sample in a shock-insulated container with the grid facing up and transport to the particle sizing and counting area.

9.7 Sample counting shall be performed in accordance with Test Methods F 312.

[4] *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.

[5] Material conforming to USP XVII, p. 995, 1965, is suitable.

10. Keywords

10.1 aerospace cleanrooms; airborne contamination; air sampling; contamination; particulate contamination; sampling