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## Standard Test Method for Gravimetric Determination of Nonvolatile Residue From Cleanroom Wipers<sup>1</sup>

This standard is issued under the fixed designation E1560; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This test method covers the determination of solvent extractable nonvolatile residue (NVR) from wipers used in assembly, cleaning, or testing of spacecraft, but not from those used for analytical surface sampling of hardware.

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

~~1.3 The NVR of interest is that which can be extracted from cleanroom wipers using a specified solvent that has been selected for its extractive qualities. Alternative solvents may be selected, but since their use may result in different values being generated, they must be identified in the procedure data sheet.~~

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~~1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.~~

~~1.3.1 Exception—The inch-pound units are included for information only.~~

~~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:*<sup>2</sup>

D1193 [Specification for Reagent Water](#)

E2217 [Practice for Design and Construction of Aerospace Cleanrooms and Contamination Controlled Areas](#)

F24 [Test Method for Measuring and Counting Particulate Contamination on Surfaces](#)

F50 [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](#)

2.2 *Military Standards:* ~~Air Force T.O. 00-25-203 Contamination Control of Aerospace Facilities, U.S. Air Force<sup>3</sup> MIL-F-51068F Filters, Particulate (High Efficiency, Fire Resistant)<sup>3</sup>~~

MIL-STD-1916 Acceptance on Zero Sampling Inspection

2.3 *Federal Standards:*

Fed Spec. O-E-00760 Ethyl Alcohol, Reagent Grade<sup>3</sup>

Fed Spec. O-T-620 1,1,1-Trichloroethane, Technical, Inhibited (Methyl Chloroform)<sup>3</sup> [Federal Standards:](#)<sup>3</sup>

Fed. Std. 209E Airborne Particulate [Cleanliness Classes for](#) ~~in~~ Cleanrooms and Clean Zones;<sup>4</sup>

2.4 *Other Documents:*

[IEST-RP-CC001 HEPA and ULPA Filters](#)<sup>5,6</sup>

[IEST-RP-CC005 Gloves and Finger Cots Used in Cleanrooms and Other Controlled Environments](#)<sup>4</sup>

<sup>1</sup> This ~~specification~~ 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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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, ~~Attn: NPODS~~ <http://dodssp.daps.dla.mil>.

<sup>4</sup> The use of Di Octyl Phthalate (DOP) in leak testing of filters or filter installation is not acceptable.

<sup>4</sup> Fed-Std-209E has been replaced by ISO 14644-1 and -2, but may continue to be used by mutual agreement.

<sup>5</sup> Fed-Std-209E has been replaced by ISO/DIS 14644-1 and -2, but may continue to be used by mutual agreement.

~~ISO/DIS 14644-1~~ ISO 14644-1 Cleanrooms and Associated Controlled Environments, Classification of air cleanliness<sup>7</sup>  
~~ISO/DIS~~ ISO 14644-2 Cleanrooms and Associated Controlled Environments, Specifications for testing and monitoring to prove continued compliance with ISO 14644-1<sup>5</sup>

### 3. Terminology

#### 3.1 Definitions:

3.1.1 *contaminant*—unwanted molecular or particulate matter that could affect or degrade the performance of the components on which they are deposited.

3.1.2 *contamination*—a process of contaminant transport or accretion or both.

3.1.3 *environmentally controlled area*—cleanrooms, clean facilities, controlled work areas, and other enclosures that are designed to protect hardware from contamination. Cleanliness is achieved by controlling airborne particulate matter, temperature, relative humidity, materials, garments, and personnel activities. Guidelines for controlled areas can be found in Table 3-1 of Air Force T.O. 00-25-203 Practice E2217.

3.1.4 *high efficiency particulate air (HEPA)*—a term describing filters having an efficiency of 99.97 % for removal of 0.3- $\mu\text{m}$  and larger particles. For this application, filters shall meet the requirements of MIL-F-51068 F1EST-RP-CC001.4-(2.2) and section 6.1 of this test method.

3.1.5 *molecular contaminant (nonparticulate)*—may be in a gaseous, liquid, or solid state. It may be uniformly or nonuniformly distributed or be in the form of droplets. Molecular contaminants account for most of the NVR.

3.1.6 *NVR*—that quantity of molecular matter remaining after the filtration of a solvent containing contaminants and evaporation of the solvent at a specified temperature.

3.1.7 *particle (particulate contaminant)*—a piece of matter in a solid state, with observable length, width, and thickness. The size of a particle is defined by its greatest dimensions and is expressed in  $\mu\text{m}$ .

### 4. Summary of Test Method

4.1 A wiper to be tested is placed in a clean blanked container and a measured volume of solvent is added to the container.

4.2 The container is placed in a heated ultrasonic cleaner and agitated by ultrasonic action for a specified period of time and the wiper is removed from the container.

4.3 The solvent in the container is filtered into another clean container and allowed to evaporate to a low volume.

4.4 The solvent is transferred to a clean pre-weighed weighing dish and evaporated to constant weight.

4.5 The results are expressed in milligrams/0.1 square metres/meters of wiper surface area or in mg/unit mass of wiper.

4.6 A control blank shall be run on all solvents, filtration components, and all other equipment associated with the analysis. In the event that more than one determination is run the same day, additional blanks will not be necessary, but will rely on the blank value from the first test.

4.7 NVR samples thus obtained will be saved for analysis to identify contaminant species if a more complete analysis is necessary.

### 5. Significance and Use

5.1 The NVR obtained by this test method is that amount which is available for release by wipers in normal use.

5.2 Evaporation of the solvent at the stated temperature is to quantify the NVR that can be expected to exist at room temperature, since the slight difference between room temperature and test temperature has not been shown to result in significant variances.

~~5.3 Numerous other methods are being used to determine NVR. This test method is not intended to replace test methods used for other applications.~~

5.3 This test method may be more aggressive than necessary for the evaluation of wipers that will be restricted to dry use only.

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### 6. Apparatus and Materials

6.1 *Unidirectional airflow work station*, 100 % exhaust for handling solvents. Must meet the particulate air cleanliness Class 25 (100), or better in accordance with ~~ISO/DIS 14644-1~~ ISO 14644-1 and ~~ISO/DIS 14644-2~~ ISO 14644-2 (Fed-Std-209), ~~latest revision when tested per Practice~~, latest revision when tested in accordance with Practice F50. HEPA filters in the work station must not have been tested with Di-Octyl Phthalate (DOP) at any time. Temperature shall be controlled within a range of 20 to 25°C and relative humidity to less than ~~50%-60 %~~ 60 %.

<sup>5</sup> The use of Di Octyl Phthalate (DOP) in leak testing of filters or filter installation is not acceptable.

<sup>6</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

<sup>6</sup> Available from Institute of Environmental Sciences and Technology (IEST), Arlington Place One, 2340 S. Arlington Heights Rd., Suite 100, Arlington Heights, IL 60005-4516, <http://www.iest.org>.

<sup>7</sup> Analytical Balance, capable of measuring to 0.01 mg.

<sup>7</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

- 6.2 ~~Solvent, 1,1,1-Trichloroethane per Fed Spec. O-T-620.~~
- 6.3 ~~Solvent, Ethanol, per Fed Spec. O-E-00760.~~
- 6.4 ~~Analytical balance, 0.01-mg readability, 0.1-mg precision. Capacity to be determined by user.~~
- 6.5 ~~6.3 Vacuum filtration system, 25-mm diameter, consisting of a membrane filter funnel and vacuum pump that will provide a pressure of 250 Torr (20-in. Hg vac.). See Fig. 1. Other size filters-filtration systems may be used as needed. All items that will come in contact with solvents during analysis shall be of glass, stainless steel, or other material that will not affect the analysis via induced contamination. Any house vacuum system may be used.~~
- 6.6 ~~6.4 Solvent resistant membrane filters, Fluorocarbon, 25-mm diameter, 0.2-µm nominal pore size.<sup>8</sup> The use of supported membrane filters is not recommended because of possible adverse effects of the solvent on the support media.~~
- 6.7
- 6.5 ~~Teflon-coated tweezers, or hemostat, unserrated tips.~~
- 6.8
- 6.6 ~~Beakers, low form glass, 500 ml.~~
- 6.9
- 6.7 ~~Laboratory detergent, liquid.~~
- 6.10
- 6.8 ~~Methanol, Reagent grade, A.C.S.~~
- 6.11
- 6.9 ~~Acetone, Reagent grade, A.C.S.~~
- 6.12
- 6.10 ~~Deionized water, organic free, Type II per Specification D1193 with a minimum resistivity of 1.0 MΩ/cm-MΩ-cm.~~
- 6.13 ~~6.11 Gloves, Barrier-type, low particle-generating, low outgassing, per I.E.S. Recommended Practice RP-CC-005-88.~~

<sup>8</sup> Nuclepore Corp. PTFE Filinert membrane filter, P/N 130606, and Millipore Corp. Fluoropore filter, P/N 02500 have been found to be satisfactory. Other equivalent, solvent-resistant filters may be used. Larger diameter filters to fit larger filter assemblies are acceptable.

The sole source of supply of the apparatus known to the committee at this time is Nuclepore Corp. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend.

TEST REPORTING FORM  
NVR DATA SHEET

SAMPLE IDENTIFICATION	_____		
MATERIAL TYPE	_____		
SIZE, COLOR, ETC.	_____		
SPECIFICATION	_____		
DATE RECEIVED		DATE TESTED	_____
REQUESTER	DEPT	TEL. NO.	_____
REQUESTER	DEPT	TEL. NO.	_____
TYPE OF SOLVENT USED	PER 6.14	OTHER	_____
TYPE OF SOLVENT USED	_____		

RESULTS PER UNIT AREA:			
MASS OF DISH AND RESIDUE	(A)	_____	MG
MASS OF WEIGHING DISH	(B)	_____	MG
BLANK OF SOLVENT	(C)	_____	MG
SURFACE AREA	(D)	_____	MG
NVR EXTRACTED FROM SAMPLE		_____	MG/0.1 m <sup>2</sup>
TO SPEC	YES	_____	
	NO	_____	
RESULTS PER UNIT MASS:			
MASS OF DISH AND RESIDUE	(E)	_____	MG
MASS OF WEIGHING DISH	(F)	_____	MG
MASS OF SOLVENT	(G)	_____	MG
MASS OF WIPER	(H)	_____	MG
NVR EXTRACTED FROM WIPER		_____	MG/GRAM
TO SPEC	YES	_____	
	NO	_____	

COMMENTS (use additional sheets if necessary) \_\_\_\_\_

ANALYZED BY \_\_\_\_\_

PRINT NAME \_\_\_\_\_

SIGNATURE \_\_\_\_\_

**FIG. 1 Test Reporting Form—NVR Data Sheet**