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## Standard Guide for Documenting the Results of Airborne Particle Penetration Testing of Protective Clothing Materials<sup>1</sup>

This standard is issued under the fixed designation F2053; 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.

### INTRODUCTION

While test methods exist to measure penetration of airborne particles through barrier specimens, the data are not reported in a standard fashion. To be useful, such data should be combined with information that characterizes the test method employed. This information includes descriptions of test materials, challenge particles, test apparatus, methods used to count and measure the particles, and test parameters such as flow rate, pressure drop, humidity, and temperature. The flow rate, pressure drop, particle size, and detection limits are of particular importance when comparing data from different sources during the selection of protective clothing. Some reports on particle barrier testing do not include such specificity. This guide provides a standard format for recording important test parameter information and data. The standard format is intended to facilitate the use of electronic databases to store, retrieve, and apply test results.

### 1. Scope

1.1 This guide provides a format for documenting information and performance data for an airborne particle penetration test.

1.2 Documented data and information are grouped into five categories that define important aspects of each test:

- 1.2.1 Description of material tested,
- 1.2.2 Challenge particles,
- 1.2.3 Test method,
- 1.2.4 Test results, and
- 1.2.5 Source of the data.

1.3 Use of this guide is facilitated by adherence to procedures outlined in a standard test method.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurements are included in this standard.

1.5 *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.*

<sup>1</sup> This guide is under the jurisdiction of ASTM Committee F23 on Personal Protective Clothing and Equipment and is the direct responsibility of Committee F23.30 on Chemicals.

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### 2. Significance and Use

2.1 This guide is intended to encourage thorough and consistent documentation of airborne particle penetration testing and its results.

2.2 Uniform information and performance data increase the likelihood of selecting proper particle protective clothing by direct comparison of one material with another.

2.3 A standard format for test information and data also encourages computer storage of test results for easy retrieval, comparison, and correlations.

### 3. Data Fields

3.1 The reporting format is shown in Fig. A1.1.

3.2 If a particular field is not applicable to the testing performed, insert “not applicable” in that field. If a particular piece of data has not been obtained, insert “no data” or “unknown” in the field.

3.3 A description of each field of information follows:

3.3.1 *Description of Material Tested*—Identification of the specific protective clothing material tested to facilitate future identification of the test materials.

3.3.1.1 *Material Identification*—The manufacturer’s code, model number, catalog number or “brand name” which uniquely describes the material tested.

3.3.1.2 *Material Description*—A unique generic description of the material composition and construction, such as the composition, thickness, and weight of various layers.

3.3.1.3 *Manufacturer*—The name, postal address, e-mail address, and telephone number of the manufacturer. If unknown, then enter the source of the tested material.

3.3.1.4 *Lot Identification or Manufacture Date*—The production lot/batch identification, date or code that uniquely identifies the material tested. If this information cannot be found, enter the earliest date that the actual test sample was known to exist, for example, the purchase date, the supplier's stocking data, the shipping date, date of receipt, or testing date.

3.3.1.5 *Thickness*—The nominal thickness, in mm, of the barrier material and the test method by which this measurement was made.

3.3.1.6 *Basis Weight*—The nominal basis weight, in g/m<sup>2</sup>, of the barrier material and the test method by which this measurement was taken.

3.3.1.7 *Treatment Before Testing*—Treatment of the material specimen prior to testing. Examples are “new,” “laundered,” “flexed,” “abraded,” “after two weeks production usage,” and “after decontamination.” Any laundering or decontaminating procedures should be described or referenced. If a standard method is used to prepare or pre-treat the specimens, full reference to the method, date or version of the method, and any exceptions to the method should be specified.

### 3.3.2 *Challenge Particles:*

3.3.2.1 *Particle Composition*—A description of the composition, physical size, and method used to generate the challenge particles.

NOTE 1—The exact identity of the challenge particles is essential for the user to determine if the data will be applicable to the individual situation.

3.3.2.2 *CAS Number*—The unique registry number assigned by the Chemical Abstracts Service (CAS) of the American Chemical Society for each chemical component of the challenge particles.

3.3.2.3 *Particle Size Distribution*—Relative volumetric concentration of particles by physical size range, applicable if variable sized particles are utilized.

3.3.2.4 *Source*—The manufacturer's code, model number, catalog number or “brand name” which uniquely describes the challenge particles.

3.3.2.5 *Lot Identification or Manufacture Date*—The production lot or batch identification, or date, which uniquely identifies the challenge particles that were employed. If this information cannot be found, enter the earliest date that the actual test sample was known to exist, for example, the purchase data, the supplier's stocking date, the shipping date, date of receipt, or testing date, in a format such as “Received January 5, 1998.”

### 3.3.3 *Technique:*

3.3.3.1 *Test Method Used*—Reference the specific test method used. Include the revision year or version of the test. If a standard test is not used, list “none” and provide a complete description of the method apparatus and procedure such that someone else could duplicate the measurements.

3.3.3.2 *Deviation from Standard Test Method*—Some testing situations may require modifications to the standard test method. Differences from the standard test method in terms of conditioning, environment, apparatus, duration or challenge must be noted.

3.3.3.3 *Testing Laboratory*—Name, address, and telephone number of the testing laboratory.

3.3.3.4 *Analytical Method*—The method used to count and size the challenge particles, including a generic identification of the method, description of the test system (if not included in the test method) and identification of analyzers and components. The minimum and maximum particle size and particle concentration that can be measured by the particle counters should be described.

3.3.3.5 *Temperature and Humidity*—The temperature (°C) and humidity (% RH) of the challenge air stream.

3.3.3.6 *Test Parameters That May Not Be Specified in the Method:*

(1) *Exposed Specimen Area*—The surface area, in m<sup>2</sup>, of the test specimen exposed to the challenge particles.

(2) *Flow Rate*—The average air flow rate, m<sup>3</sup>/m<sup>2</sup>, and standard deviation, through the test specimens. This value is sometimes called face velocity and reported as m/s.

(3) *Pressure Drop*—The average pressure difference, in kPa, and standard deviation across the test specimens.

(4) *Challenge Concentration*—The concentration of particles on the exposed side of the test specimen.

(5) *Test Duration*—The length of time that the specimens were exposed to the challenge particles.

(6) *Test Sensitivity*—Based on the minimum detectable percentage penetration and determined from the ratio of the lowest detectable concentration downstream of the test material divided by the challenge particle concentration.

(7) *Particle Size Limitations*—The particle size limitations of the analytical method (largest and smallest particles observable)

3.3.3.7 *Controls*—Describe the positive controls used to demonstrate the reproducibility of the test.

### 3.3.4 *Test Results:*

3.3.4.1 *Date Tested:*

3.3.4.2 *Number of Specimens Tested*—The number of replicate specimens.

3.3.4.3 *Location of Specimens*—The part of the protective clothing from which the tested specimens were taken.

3.3.4.4 *Percent Penetration*—The observed penetration of the challenge particle through each specimen of the test material, expressed as a percentage. Calculate percent penetration by dividing the downstream particles concentration (sampling side of specimen) by the upstream particle concentration (challenge side) and multiplying this ratio by 100. The report may report percent penetration for each size range of particles.

3.3.4.5 *Other Observations*—These may include data on the change in penetration rate during the test, visual changes in the specimens, such as caking of the challenge particle, fibrillation of the specimen surface, or changes in physical properties of the specimens.

3.3.5 *Source of Data*—The name, address, and telephone number of the person completing the report.

## 4. **Keywords**

4.1 airborne particle; penetration; protective clothing

**ANNEX**

**(Mandatory Information)**

**A1. SUGGESTED FORMAT OF REPORT**

A1.1 **Fig. A1.1** is the format to be followed when documenting the results of particle penetration test on protective clothing materials.

Description of Material Tested

Material Identification \_\_\_\_\_  
 Material Description \_\_\_\_\_  
 Manufacturer \_\_\_\_\_  
 Lot Identification or Manufacture Date \_\_\_\_\_  
 Thickness \_\_\_\_\_  
 Basis Weight \_\_\_\_\_  
 Treatment Before Testing \_\_\_\_\_

Challenge Particles

Challenge Particle Composition \_\_\_\_\_  
 CAS Number \_\_\_\_\_  
 Particle Size Distribution (if applicable)  

Particle Size (um)	% Concentration

 Source \_\_\_\_\_  
 Lot Identification or Manufacture Date \_\_\_\_\_

Test Method

Standard Test Method Used \_\_\_\_\_  
 Deviation from Standard Test Method \_\_\_\_\_  
 Testing Laboratory \_\_\_\_\_  
 Analytical Method \_\_\_\_\_  
 Temperature and Humidity \_\_\_\_\_  
 Test Parameters that may not be method specified:  
 Exposed Specimen Area \_\_\_\_\_  
 Flow \_\_\_\_\_  
 Pressure Drop \_\_\_\_\_  
 Challenge Particle Concentration \_\_\_\_\_  
 Test Duration \_\_\_\_\_  
 Test Sensitivity \_\_\_\_\_  
 Particle Size \_\_\_\_\_  
 Control \_\_\_\_\_

Test Results

Date Tested \_\_\_\_\_  
 Number of Specimens Tested \_\_\_\_\_  
 Location of Specimens \_\_\_\_\_  
 % Penetration – Test Specimens  

Particle Size (um)	% Penetration


Other Observation \_\_\_\_\_  
 % Penetration - Control Results  

Particle Size (um)	% Penetration

Source of Data

Name \_\_\_\_\_  
 Address \_\_\_\_\_  
 Telephone \_\_\_\_\_

**FIG. A1.1 Format of Report**

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