



Standard Test Method for Protective Clothing Material Resistance to Puncture¹

This standard is issued under the fixed designation F 1342; 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.

^{ε1} Note—Section 11 was added editorially in January 1996.

^{ε2} Note—Reapproval date was corrected editorially in June 1996.

1. Scope

1.1 This test method determines the puncture resistance of a protective clothing material specimen by measuring the force required to cause a sharp-edged puncture probe to penetrate through the specimen.

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.*

1.3 The values stated in inch-pound units are to be regarded as the standard. The values in parentheses are for information only.

2. Referenced Documents

2.1 ASTM Standards:

D 2582 Test Method for Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheeting²

2.2 Federal Standard:

Fed. Std. No. 191, Method 5030.2 Measurement of the Thickness of Materials³

3. Terminology

3.1 Definition:

3.1.1 *protective clothing material*—any material or combination of materials used in an item of clothing for the purpose of isolating parts of the wearer's body from a potential hazard.

4. Summary of Test Method

4.1 A material specimen is placed in a stationary support assembly that is in turn affixed to the lower arm of a tension testing machine.

4.2 A pointed puncture probe of set dimensions is mounted to the penetrometer stand and the whole assembly is attached to the compression cell of the tension testing machine.

4.3 The puncture probe is moved at a constant velocity until it punctures the material specimen.

4.4 The force required to puncture the material specimen is measured by the compression cell. The elongation (or deflection) of the specimen prior to puncture is also measured. The reported puncture resistance is the average of twelve test replicates, with three replicates for each of the four material specimens tested.

5. Significance and Use

5.1 This test method evaluates puncture resistance of protective clothing materials which may include plastics or elastomeric films, coated fabrics, flexible materials, laminates, or textile materials.

5.2 This test method is not intended to measure puncture resistance of all types of punctures encountered using protective clothing material. This test method involves a procedure where a puncture probe of specified dimensions is used for puncturing specimens.

5.3 This test method evaluates puncture resistance of protective clothing materials, specifically for puncture forced on specimens perpendicular to material surface. There is no supporting structure under the material specimen.

5.4 Evaluation of puncture resistance for snag-type puncture should be performed in accordance with Test Method D 2582.

6. Apparatus

6.1 *Thickness Gage*, suitable for measuring thickness to the nearest 0.01 mm (or the nearest 0.001 in.), as specified in Fed. Std. No. 191, Method 5030.2, shall be used to determine the thickness of each protective clothing specimen tested.

6.2 *Testing Machine*, shall meet the following criteria:

6.2.1 It shall be capable of holding the specimen securely between the two clamps.

6.2.2 It shall be capable of straining the specimen with a uniform movement of the pulling clamp.

6.2.3 A calibrated dial, scale, or chart shall be used to indicate applied load and elongation. Unless otherwise specified for load determination, the machine shall be adjusted or set so that the maximum load required to puncture the specimen remains on the calibrated dial or scale after the test specimen has ruptured.

¹ This test method is under the jurisdiction of ASTM Committee F-23 on Protective Clothing and is the direct responsibility of Subcommittee F23.20 on Physical Properties.

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² Annual Book of ASTM Standards, Vol 08.02.

³ Available from Standardization Documents, Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

6.2.4 The error of the machine shall not exceed 2 % at any reading within its loading range.

6.2.5 It shall be outfitted with a compression cell. The testing machine may be configured with the compression cell on either the lower or upper arm.

6.3 *Puncture Probe*, shall be fabricated to meet the requirements shown in Fig. 1. The puncture probe shall be fabricated from stainless steel with a Rockwell Hardness of 35 to 40.

6.4 *Specimen Support Assembly*, shall consist of two flat metal specimen support plates that clamp together so the sample specimen is held tightly between them. It shall also consist of a machine interface plate that can be connected to the testing machine.

6.4.1 Each plate shall have one or more $\frac{1}{4}$ -in. (0.6-cm) diameter holes. For efficiency in testing, three holes spaced at the points for a 60° equilateral triangle having 1-in. (2.5-cm) legs centered within the plate may be used. Each hole shall be located $\frac{3}{4}$ in. (1.9 cm) from the plate edge and 1 in. (2.5 cm) from each of the other holes, as shown in Fig. 2.

6.4.2 The two specimen support plates shall be connected to the testing machine using a machine interface plate.

6.5 *Template*, shall be used to locate the holes for specimen mounting in the support assembly, as shown in Fig. 3.

7. Test Specimens

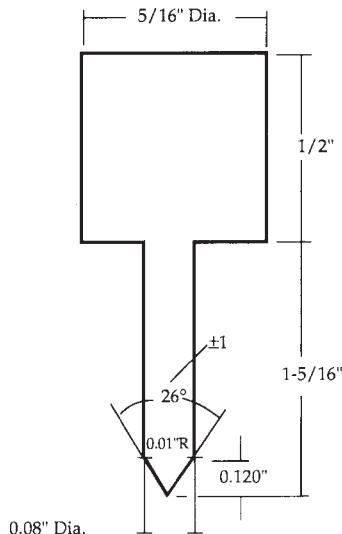
7.1 Four test specimens, 8.9 cm^2 (3.5 in.^2) each, shall be prepared. No sample conditioning is required.

8. Procedure

8.1 Measure the thickness of each specimen to the nearest 0.01 mm (1 mil) and record.

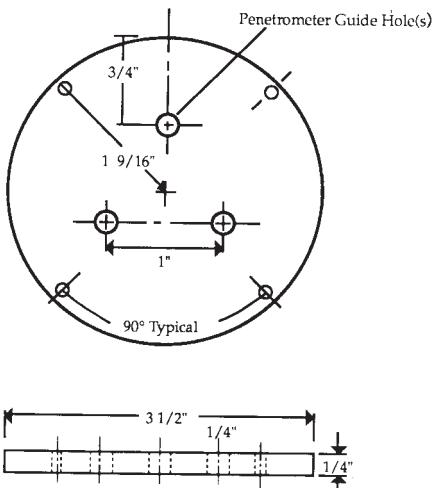
8.2 Mount the material specimen to be tested in the support assembly as shown in Fig. 4. Mark the two plates and take care that the holes are aligned prior to testing to avoid damaging the penetrometer and plates.

8.3 Attach the material support assembly to the movable arm of the test apparatus.



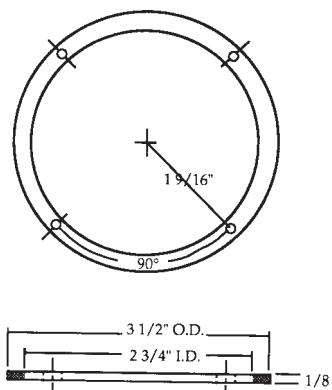
NOTE 1—All dimensions are in inches (1 in. = 2.54 cm).

FIG. 1 Cross-Section of Puncture Probe



NOTE 1—All dimensions are given in inches (1 in. = 2.54 cm).

FIG. 2 Support Plate (Two Required)



NOTE 1—All dimensions are given in inches (1 in. = 2.54 cm).

FIG. 3 Template

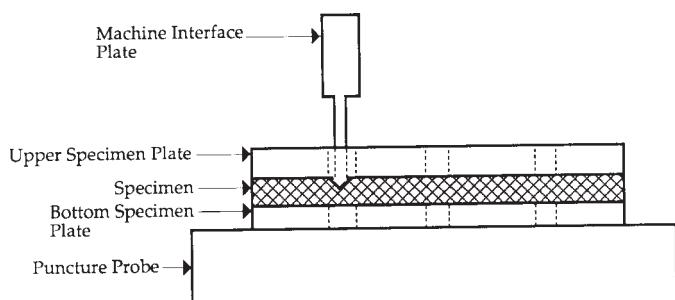


FIG. 4 Side View of Specimen Support Assembly

8.4 Position puncture probe on the compression cell of the test apparatus, as shown in Fig. 5.

8.5 Set the testing machine in operation, but stop it when the penetrometer has been driven through the sample specimen. The penetrometer shall have a velocity of 50.8 cm/min (20 in./min) under load conditions and shall be uniform at all times.

8.6 Record the maximum force registered by the indicating device to the nearest 0.1 lb (nearest 50 g) for each determination.

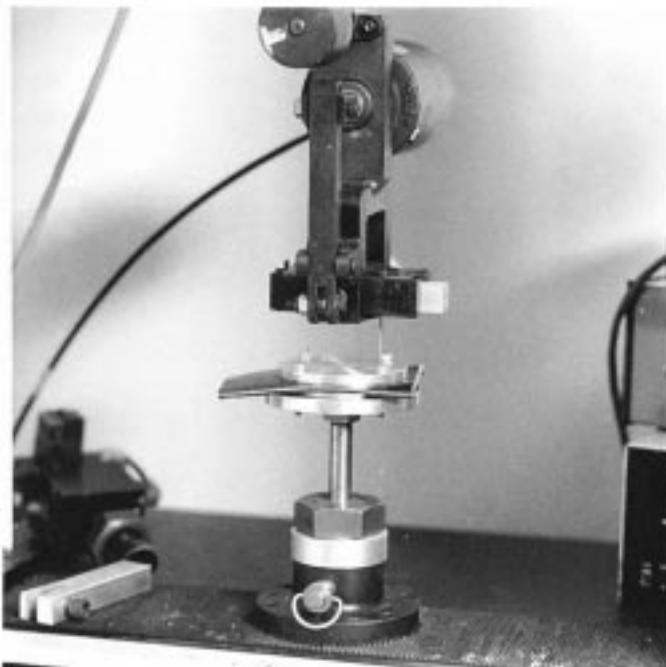


FIG. 5 Puncture Test Apparatus

8.7 Record the deflection of the sample to the nearest 0.6 cm (0.2 in.) prior to puncture.

8.8 If the sample specimen has not been penetrated, record a maximum force of 50 lb (23 kg).

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8.9 After the first test is complete, reposition the penetrometer under each of the remaining guide holes and repeat the test until three punctures have been made in each material specimen.

8.10 Conduct a total of twelve puncture resistance measurements.

9. Report

9.1 Report the following information:

9.1.1 Describe the type of material tested including the thickness of each specimen to the nearest 0.01 mm (0.001 in.). Calculate and report the average thickness.

9.1.2 Report the force required for each puncture to the nearest 50 g (0.1 lb) in all twelve test replicates. Calculate and report the average puncture force.

9.1.3 Report the deflection that occurs for each puncture to the nearest 0.5 cm (0.2 in.) in all twelve test replicates. Calculate and report the average puncture force.

10. Precision and Bias

10.1 *Precision*—The precision of this test method is being determined.

10.2 *Bias*—Since there is no accepted reference material suitable for determining the bias for the procedure in this test method for measuring puncture resistance of protective clothing materials, bias has not been determined.

11. Keywords

11.1 protective clothing materials; puncture; puncture resistance