



Standard Test Method for Protrusion Puncture Resistance of Stretch Wrap Film¹

This standard is issued under the fixed designation D 5748; 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 determines the resistance of a stretch wrap film to the penetration of a probe at a standard low rate, a single test velocity. Performed at standard conditions, the test method imparts a biaxial stress that is representative of the type of stress encountered in many product end-use applications. The maximum force, force at break, penetration distance, and energy to break are determined.

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:

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing²

D 996 Terminology of Packaging and Distribution Environments³

D 1898 Practice for Sampling of Plastics²

D 2103 Specification for Polyethylene Film and Sheet²

E 122 Practice for Choice of Sample Size to Estimate a Measure of Quality for a Lot or Process⁴

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method⁴

3. Terminology

3.1 *Definitions*—General definitions for packaging and distributions environments are found in Terminology D 996.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *break force*—force achieved at break.

3.2.2 *energy*—work to break.

3.2.3 *maximum force*—greatest force achieved.

3.2.4 *penetration distance*—depth probe traveled in penetrating film specimen, from initial probe contact with film specimen, to penetration at break.

3.2.5 *protrusion puncture resistance*—the ability of a plastic film to withstand the force exerted by a protrusion.

3.2.6 *thickness (caliper, gage)*—the perpendicular distance between the opposite surfaces of a plastic film.

4. Significance and Use

4.1 Puncture resistance is very important in end-use performance of stretch wrap film used in consumer and industrial product applications. Puncture resistance is a measure of the energy-absorbing ability of a stretch wrap film in resisting a protrusion. The test method is designed to provide the user with a means of measuring the stretch wrap film's puncture resistance performance under essentially biaxial deformation conditions. A biaxial stress is representative of the type of stress encountered by stretch wrap products in many end-use applications.

4.2 Although this test method cannot be expected to duplicate all field experiences, since the rate of speed, weight, and configuration of such destructive forces vary widely, a generally reliable comparison of samples may be made from the data obtained.

5. Apparatus

5.1 *Universal Testing Apparatus.*

5.2 *Integrator and Chart Recorder.*

5.3 *Appropriate Load Cell*—The test may be performed using compression or tension load cell.

5.4 *Probe*—A 0.75 in. (19 mm) diameter pear-shaped TFE-fluorocarbon coated probe⁵ (Fig. 1), for general application and standard comparison of plastic films and interlaboratory results.

5.5 *Specimen Clamping Fixture* (Fig. 2).

5.6 *Micrometre*, conforming to Specification D 2103.

5.7 *Template*, 6 by 6 in. (150 by 150 mm).

5.8 *Specimen Cutter.*

6. Sampling

6.1 *Acceptance Sampling*—Sampling shall be in accordance with Practice D 1898.

6.2 *Sampling for Other Purposes*—The sampling and the number of test specimens depend on the purpose of the testing. Practice E 122 is recommended. Test specimens are taken from several rolls of film, and where possible, from several production runs of film. Strong conclusions about a specific property of a film cannot be based on a single roll of film.

¹ This guide is under the jurisdiction of ASTM Committee D-10 on Packaging and is the direct responsibility of Subcommittee D10.25 on Palletizing and Unitizing of Loads.

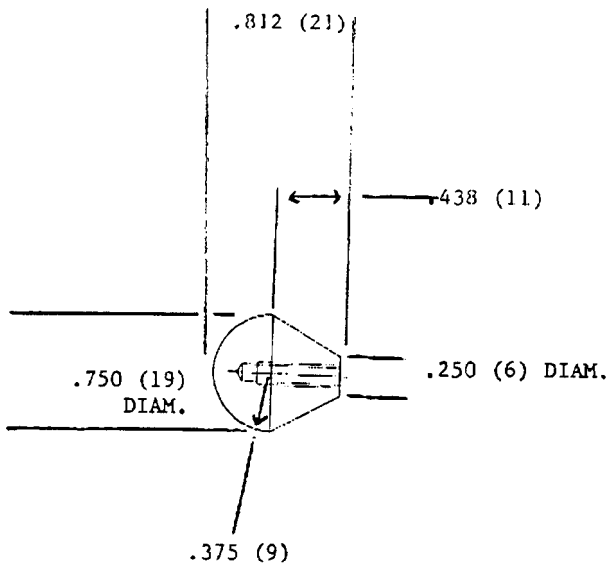
Current edition approved July 15, 1995. Published September 1995.

² *Annual Book of ASTM Standards*, Vol 08.01.

³ *Annual Book of ASTM Standards*, Vol 15.09.

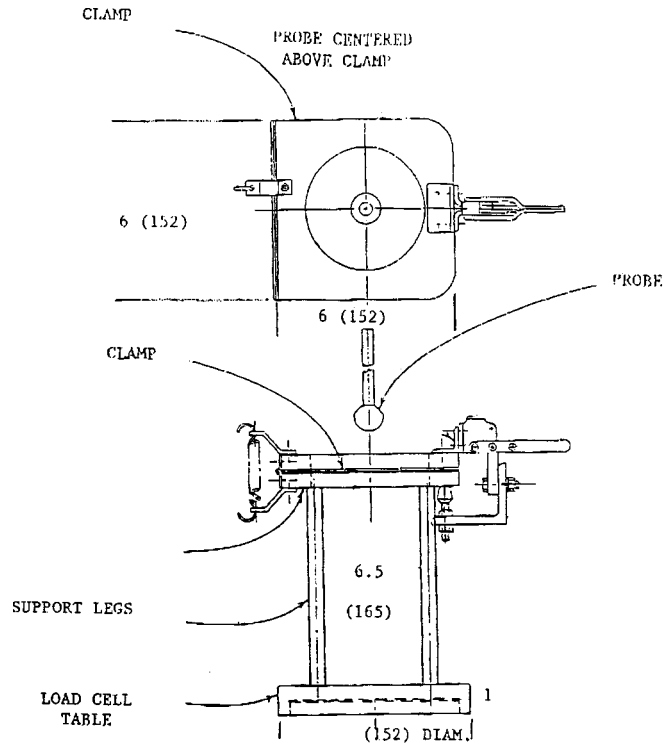
⁴ *Annual Book of ASTM Standards*, Vol 14.02.

⁵ The probe is coated with duPont 954-101 Teflon S a thickness of 0.0015 in. (0.0381 mm). Available from duPont.



PROBE IS TEFLON COATED

NOTE 1—Measurements are in inches (millimetres).
FIG. 1 Probe



NOTE 1—Measurements are in inches (millimetres).
FIG. 2 Clamp

7. Number of Test Specimens

7.1 Test a minimum of five specimens for each sample.

8. Preparation of Apparatus

8.1 For specific instruction in setting up and operating the apparatus, consult the operations manual.

8.2 Install probe apparatus (Fig. 2).

8.3 Center the probe (Fig. 1) over the specimen clamping fixture (Fig. 2).

9. Conditioning

9.1 Condition the test specimens at $73.4 \pm 3.6^\circ\text{F}$ ($23 \pm 2^\circ\text{C}$) and $50 \pm 5\%$ relative humidity for not less than 40 h prior to testing in accordance with Procedure A of Practice D 618.

9.2 Conduct tests in the standard laboratory atmosphere of $23 \pm 2^\circ\text{C}$ ($73.4 \pm 3.6^\circ\text{F}$) and $50 \pm 5\%$ relative humidity unless otherwise specified in the test method.

10. Procedure

10.1 With the probe apparatus installed, calibrate the test equipment following the manufacturer's instructions.

10.2 Select an equipment load range so that specimen puncture occurs within 20 to 80 % of the same.

10.3 Using the template and specimen cutter, prepare a minimum of five specimens from each sample.

10.4 Measure the caliper (average of three readings) in the center of each specimen and record the average.

10.5 Set universal tester crosshead speed at 10 in./min (250 mm/min) and chart recorder speed at 10 in./min (250 mm/min). If using an integrator instead of a data acquisition system, set the counters to zero.

10.6 Clamp the specimen in the holder. Lower the probe as close as possible to the specimen without actually touching.

10.7 Set the appropriate stops and returns on the universal tester. Reset data collection devices if applicable.

10.8 Activate the universal tester. Stop the crosshead when the puncture probe passes completely through the film. Where holes occur other than at the probe point, the specimen test results should be discarded. See Fig. 3.

10.9 Record specimen identification, peak force at break, maximum force, energy (work) to break, and probe penetration distance at break, from mechanical testing software output. If using chart recording instruments, record specimen identification on chart and integrator reading if used. Return crosshead to start position and remove specimen. See Fig. 4 for graphical output of test performed.

10.10 Repeat test sequence (10.1 through 10.9) for the remaining sample specimens.

11. Calculations

11.1 Compute the values of peak force at break, maximum force, energy (work) to break and probe penetration distance. In some instances, peak force at break and maximum force will