Designation: F 88 – 00

Standard Test Method for Seal Strength of Flexible Barrier Materials[1]

This standard is issued under the fixed designation F 88; 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 covers the measurement of the strength of seals in flexible barrier materials.

1.2 The test may be conducted on seals between a flexible material and a rigid material.

1.3 Seals tested in accordance with this test method may be from any source, laboratory or commercial.

1.4 This test method measures the force required to separate a test strip of material containing the seal. It also identifies the mode of specimen failure.

1.5 SI units are preferred. The values given in parentheses are for information only.

1.6 *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 consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 882 Test Methods for Tensile Properties of Thin Plastic Sheeting[2]

D 1898 Practice for Sampling of Plastics[3]

E 171 Specification for Standard Atmospheres for Conditioning and Testing Flexible Barrier Materials[4]

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method[5]

3. Terminology

3.1 *Definitions:*

3.1.1 *average seal strength*, *n*—average force per unit width of seal required to separate progressively a flexible material from a rigid material or another flexible material, under the conditions of the test.

3.1.1.1 *Discussion*—The average force normally is calculated by the testing machine from the digitized plot of force versus grip travel. The plot starts from zero force after slack has been removed from the test strip. The initial ramp-up from zero to the force level required to peel the seal is not indicative of seal strength, and data from that part of the curve should not be included in the calculation of average strength, nor should the return to zero following complete failure of the specimen. The amount of data actually discarded on each end of the measured seal-profile curve must be the same for all tests within any set of comparisons of average seal strength (see 6.1.1 and 9.8.1).

3.1.2 *flexible*, *adj*—indicates a material with flexural strength and thickness permitting a turn back at an approximate 180 degree angle.

3.1.3 *maximum seal strength*, *n*—maximum force per unit width of seal required to separate progressively a flexible material from a rigid material or another flexible material, under the conditions of the test.

4. Significance and Use

4.1 Seal strength is a quantitative measure for use in process validation, process control and capability. Seal strength is not only relevant to opening force and package integrity, but to measuring the packaging processes' ability to produce consistent seals. Seal strength at some minimum level is a necessary package requirement, and at times it is desirable to limit the strength of the seal to facilitate opening.

4.1.1 The maximum seal force is important information, but for some applications, average force to open the seal may be useful, and in those cases also should be reported.

4.2 When a seal fails adhesively (peel seal) the value of the bond strength measured is reported. A cohesive failure of the bond, delamination, or failure elsewhere in the test strip indicates that the substrate, not the seal interface, would be the limiting factor in the strength of a package. In those cases seal strength may be reported as "no less than" the strength measured.

4.3 A portion of the force measured when testing materials may be a bending component and not seal strength alone. A number of fixtures and schemes have been devised to hold samples at various angles to the pull direction to control this bending force. Because the effect of each of these on test results is varied, consistent use of one technique throughout a

[1] This test method is under the jurisdiction of ASTM Committee F2 on Flexible Barrier Materials and is the direct responsibility of Subcommittee F02.30 on Test Methods.

Current edition approved May 10, 2000. Published July 2000. Originally published as F 88 – 68. Last previous edition F 88 – 99.

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

[3] Discontinued 1998; see *Annual Book of ASTM Standards*, Vol 08.01.

[4] *Annual Book of ASTM Standards*, Vol 15.09.

[5] *Annual Book of ASTM Standards*, Vol 14.02.

test series is recommended. Examples of fixtures and schemes are illustrated in Fig. 1.

5. Interferences

5.1 The value obtained for seal strength can be affected by properties of the specimen other than seal strength. These interferences are discused in the annex.

6. Apparatus

6.1 *Tensile Testing Machine*—A testing machine of the constant rate-of-jaw-separation type. The machine shall be equipped with a weighing system that moves a maximum distance of 2 % of the specimen extension within the range being measured. The machine shall be equipped with a device for recording the tensile load and the amount of separation of the grips; both of these measuring systems shall be accurate to ±2 %. The rate of separation of the jaws shall be uniform and capable of adjustment from approximately 200 to 300 mm (8 to 12 in.)/min. The gripping system shall be capable of minimizing specimen slippage and applying an even stress distribution to the specimen.

6.1.1 If calculation of average seal strength is required, the testing machine system shall have the capability to calculate its value over a specified range of grip travel programmable by the operator. Preferably, the machine shall have the capability also to plot the curve of force versus grip travel.

6.2 *Specimen Cutter*, conforming to the requirements of 5.4 of Test Methods D 882, sized to cut specimens to a width of 25 mm (0.984 in.), 15 mm (0.591 in.), or 25.4 mm (1.00 in.). Tolerance shall be ±0.5 %.

7. Sampling

7.1 The number of test specimens shall be chosen to permit an adequate determination of representative performance. Practice D 1898 provides guidance for test specimen selection.

7.2 Testing of samples with visual defects or other deviations from normality may or may not be appropriate depending on the purpose of the investigation. Indiscriminate elimination of defects can bias results.

8. Aging and Conditioning

8.1 In the absence of information showing that heatseal strength stability of the materials under test is reached in shorter times, condition and test sealed materials in accordance with Specification E 171, with a minimum conditioning time of 40 h or longer if shown to be required to reach stability.

8.2 Heatseal conditioning periods may be shortened to times determined by experimentation as sufficient to achieve seal strength stability.

8.3 Modification of conditioning practices may be necessary to meet specific test objectives, such as the measurement of seal strength at specified storage or handling temperature.

9. Procedure

9.1 Calibrate the tensile machine in accordance with the manufacturer's recommendations.

9.2 Prepare sealed test specimens for testing by cutting to the dimensions shown in Fig. 2. Edges shall be clean-cut and perpendicular to the direction of seal. Specimen legs may be shorter than shown, depending on the grip dimensions of the testing machine.

9.3 Clamp each leg of the test specimen in the tensile testing machine. The sealed area of the specimen shall be approximately equidistant between the grips. Recommended distance between grips (initial unconstrained specimen length) is:

Fin and Hot-Wire Seals		
Highly[A] extensible materials:	10 mm	(0.39 in.)
Less[A] extensible materials:	25 mm	(1.0 in.)
Lap Seals:	X + 10 mm[B]	

[A] Grip separation distance is recommended to be limited for highly extensible materials (100 + % elongation at seal failure) to minimize interferences (see annex).

[B] Refer to Fig. 2 for definition of *X*.

9.4 Center the specimen laterally in the grips. Align the specimen in the grips so the seal line is perpendicular to the direction of pull, allowing sufficient slack so the seal is not stressed prior to initiation of the test.

9.5 A significant difference in measured seal strength has been shown to result, depending on the orientation of a fin-seal

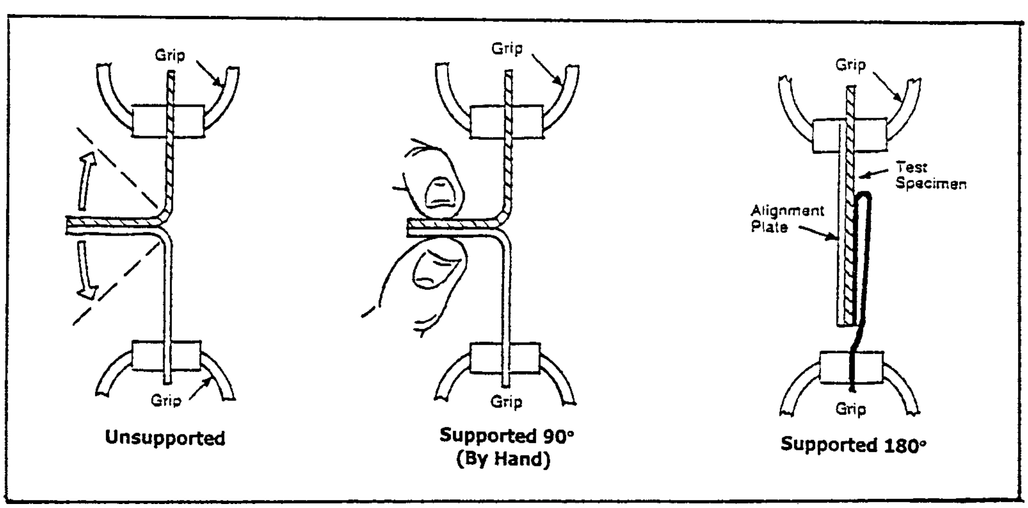
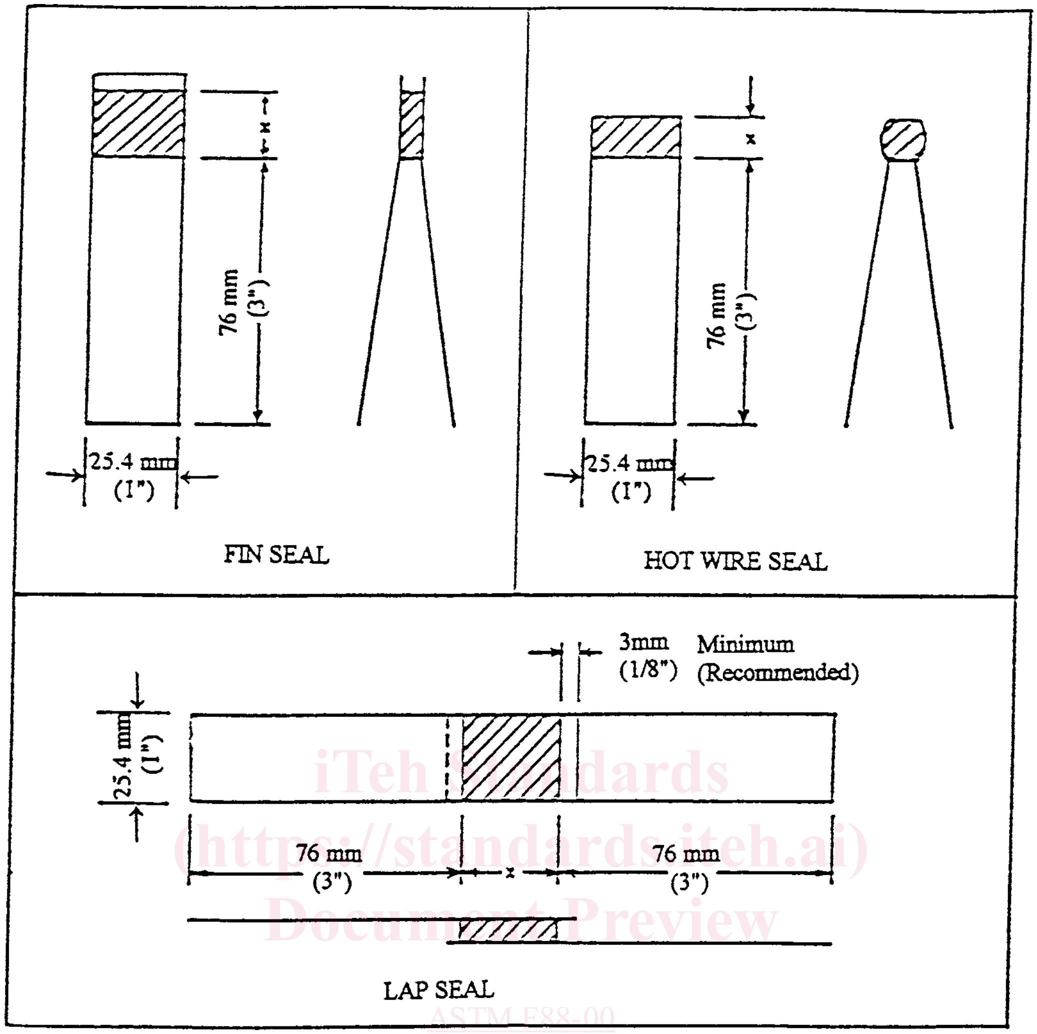


FIG. 1 Tail Holding Methods



NOTE 1—Seal dimension marked X varies with sealer configuration.

FIG. 2 Recommended Specimen Dimensions

tail during the test. The test report should indicate the details of any method used to control tail orientation.

9.6 The seal shall be tested at a rate of grip separation of 200 to 300 mm/min. (8 to 12 ipm).

9.7 For each cycle, report the maximum force encountered as the specimen is stressed to failure and identify the mode of specimen failure.

9.8 If the test strip peels apart in the seal area, either by adhesive failure, cohesive failure, or delamination, the average peel force may be an important index of performance and should be measured by the testing machine as a part of the test cycle.

9.8.1 Follow the machine manufacturer's instructions to select the desired algorithm for calculating average seal strength. Fig. 3 illustrates the effect of an algorithm that uses data only from the central 80 % of the curve to calculate the average.

9.8.2 If the test strip does not peel significantly in the seal area and failure is largely by breaking, tearing, or elongation of the substrate material, average force to failure may have little significance in describing seal performance and should not be reported in such cases (see Annex A1.1).

9.9 A plot of force versus grip travel may be useful as an aid in interpretation of results. In those cases, the testing machine should be programmed to generate the plot.

9.10 Other properties, such as energy to cause seal separation, may be appropriate in cases where grip travel results only in peel. When other failure modes (delamination, elongation, break, tear or other) are present in addition to peel of the seal, energy, and other functions must be interpreted with caution.

10. Report

10.1 Report the following:

10.1.1 Complete identification of material being tested.

10.1.2 Equipment and test method or practice used to form seals, if known.

10.1.3 Equipment used to test seals.

10.1.4 Ambient conditions during tests; temperature and humidity.

10.1.5 Grip separation rate.