Designation: F2054/F2054M – 13

Standard Test Method for Burst Testing of Flexible Package Seals Using Internal Air Pressurization Within Restraining Plates[1]

This standard is issued under the fixed designation F2054/F2054M; 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 These test methods cover the procedure for determining the minimum burst strength of a seal placed around the perimeter of a flexible package as it is internally pressurized and enclosed within restraining plates.

1.2 The test methods described herein are functionally similar to Test Methods F1140 with the exception of the use of restraining plates. Test Methods F1140 describes methods of burst testing that do not include the use of restraining plates and are suitable to determine a packages general ability to withstand pressurization stresses. Under Test Methods F1140 the stresses are not distributed uniformly to all areas of the package seal. Under unrestrained conditions the stress on the package is highest at the middle of the pouch where it inflates to the packages maximum diameter; therefore, Test Methods F1140 may not reliably detect the weakest area of the seal.

1.3 The burst test internally and increasingly pressurizes a package until an area of the package seal around the perimeter "bursts" open in response to pressurization. By placing the package within restraining plates during pressurization, the dimensional stability of the package is maintained in a manner that results in stresses applied more uniformly along the perimeter of the package, where seals are normally placed. This allows the test to have a higher probability of detecting the weakest area of the seal and provide a measurement of the pressure required to "burst" open the package.

1.4 This test only applies to flexible packages with seals placed around the perimeter of a flexible package (often referred to as a pouch). In particular it is intended as applicable to packages with seals that have a peelable seal feature (peeled open by end user to remove contents of package).

1.4.1 Porous barrier materials' failure to reach adequate pressure to burst the package seals may be due to insufficient volume flow. See Appendix X4 for information.

1.5 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

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 establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* Particular caution is advised where users of this procedure may be required to design and fabricate restraining plate fixtures. Reference Appendix X3 for further information regarding calculation of stress factors and structural design considerations.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E171 Practice for Conditioning and Testing Flexible Barrier Packaging

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

F17 Terminology Relating to Flexible Barrier Packaging

F88 Test Method for Seal Strength of Flexible Barrier Materials

F1140 Test Methods for Internal Pressurization Failure Resistance of Unrestrained Packages

3. Terminology

3.1 *Definitions*—For definitions and terms used in this test method, refer to Terminology F17 for standardized terminology for flexible barrier packaging.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *restraining plates, n*—refers to plates that are rigid in nature and configured to contact and limit the packages expandable surface area as the package is pressurized.

[1] This test method is under the jurisdiction of ASTM Committee F02 on Flexible Barrier Packaging and is the direct responsibility of Subcommittee F02.20 on Physical Properties.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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4. Summary of Test Method

4.1 Packages are tested in an apparatus that internally pressurizes the package until an area of the package ruptures (burst). For most applications the rupture (burst) will occur at one or more areas of the seal. The pneumatic supply and pressurization equipment need the capability to maintain an increasing pressure until the seal area fails. (For porous barrier material, see Appendix X4.) During pressurization, the package shall be enclosed between two rigid and parallel plates (restraining plates) that limit the expansion and dimensional distortion of the package but allow the seal perimeter area to be unrestricted. A sensor inside the package detects the internal pressure at the point at which the package ruptures (burst). Dependent on the application, two configurations of restraining plates are indicated for use with this test method. Generally, these are described as follows:

4.1.1 *Open Package Configuration* —An open package configuration is used where there is a seal placed around three sides of the package perimeter and the fourth side is open. This configuration is generally used in the original package manufacture. See Fig. 1 for an illustration of the configuration used.

4.1.2 *Closed Package Configuration* —A closed package configuration is used where there is a seal placed around all four sides of the package. This configuration generally is used in operations where the purpose is to test the seal in it's finished, fully-sealed state. See Fig. 2 for an illustration of the configuration used.

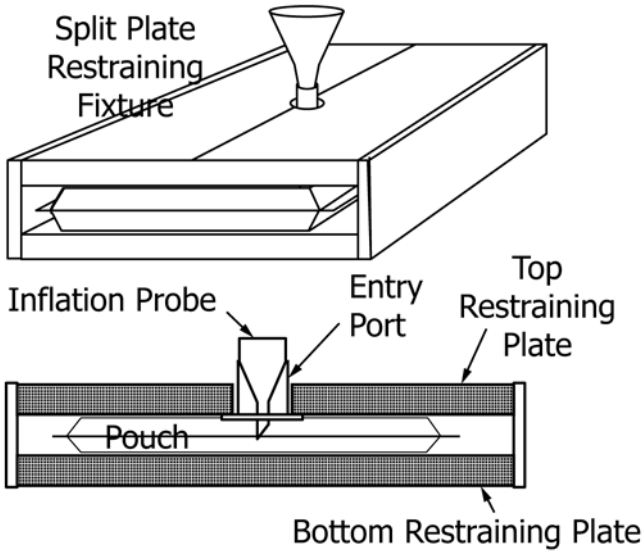

FIG. 2 Restraining Plates, Closed Package Configuration

5. Significance and Use

5.1 This test provides a rapid means of evaluating tendencies for package seal failure when the package is exposed to a pressure differential. Pressure differentials may occur during such processes as sterilization and transportation. This test method provides an indicator of the burst strength of a package, where the burst will normally occur in one or more areas of the seal. An indicator of the minimum burst strength may be of importance to the package manufacturer and end user in ensuring adequate package integrity. This test method cannot provide a measure of package seal uniformity. This test method also cannot provide an evaluation of overall package integrity or the burst strength of areas of the package that contact the surface of the restraining plates used. This test method should be combined with other methods of evaluating overall package integrity, uniformity of the package seal, or opening functionality, if so required.

5.2 This test frequently is used to quickly evaluate package seal strength during the manufacturing process and at various stages of the package's life cycle.

5.3 If correlations between pieces of test equipment are to be made it is important that all parameters of the test be equivalent. Typical parameters can include, but are not limited to the package size, material, type and configuration of seal, rate of air flow into the package, pressure detection sensing mechanism and sensitivity (machine response to pressure drop), position of test article, rigidity of restraining plates, and distance between restraining plates. See Appendix X2 for further information.

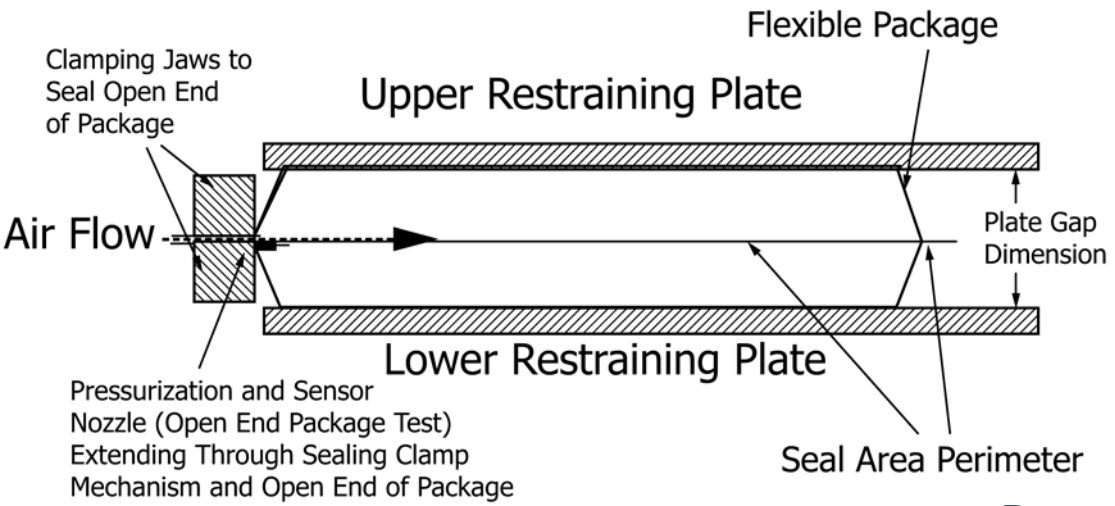

FIG. 1 Restraining Plates, Open Package Configuration

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5.4 This test may not necessarily provide correlation with package seal strength as typically measured using Test Methods F1140 or F88 (or equivalents).

6. Apparatus

6.1 Packages are tested under conditions described as follows:

6.1.1 *Open-Package Tester*—Open-package test fixtures are used to test flexible packages with one of the four sides of the package open (nonsealed). The package is pressurized with an inflation nozzle and pressure sensing mechanism inserted into the open end of the package. The open end then is sealed by a clamping mechanism for the duration of the test (see Fig. 1).

6.1.2 *Closed-Package Tester*—Closed-package test fixtures are used to test packages with all four sides of the package sealed. The closed package tester internally pressurizes the package utilizing a pressure nozzle and sensing mechanism that is connected through a puncture in the package (see Fig. 2).

6.2 The test apparatus for both open and closed package testing shall include the following:

6.2.1 An air supply and pressure regulating mechanism that can produce sufficient air flow to pressurize the package to the point of package failure (burst); for porous barrier materials, see Appendix X4;

6.2.2 A means of detecting a rapid pressure drop inside the package that signals that an area of the package is stressed to failure (burst);

6.2.3 A means of measuring the internal pressure at the point in which a rapid pressure drop occurs as the result of seal or other package failure (burst);

6.2.4 Two restraining plates that are configured similar to as shown in Fig. 1 or Fig. 2, is rigid to movement and flex, and contact the expandable surface area of the package for the duration of the test.

6.2.5 The following depending on type of test conducted.

6.2.5.1 Open-package test fixtures shall have a pressurization nozzle and sensor that is inserted into the open end of the package, and a clamping mechanism that seals the open end of the package, as well as creates an air tight seal around the pressurization nozzle and sensor; and

6.2.5.2 Closed-package test fixtures shall have a pressurization nozzle and sensor that inserts into a puncture of the body of the sealed package while maintaining an air tight seal around those mechanisms.

7. Sampling

7.1 *Sampling*—Choose the number of test specimens to permit an adequate determination of representative performance.

8. Conditioning

8.1 *Standard Test Conditions*—Condition the packages for a minimum of 72 h before performing test. Reference Specification E171 for further information on standard conditioning.

8.2 Effects of environmental conditions other than the above standards have not been determined as they relate to the results of this test method and may depend on packaging materials used. Where comparisons or correlation's of test results may be a requirement, and the test is conducted in other than standard test conditions, record the conditioning factors and the temperature and relative humidity at the time of test.

9. Procedure

9.1 *Package Preparation*—The package may be tested with, if the package can fit within the restraining plates, or without product enclosed inside the package. Record the package test preparation, if applicable.

9.2 *Open-Package Test:*

9.2.1 Insert the package in a manner in which the body of the package is enclosed between the restraining plates. Place the package between the restraining plates in a manner which minimizes the unrestrained areas of the package during the test. It is advised to use some type of markings or fixturing that ensures consistent placement for all packages tested. Ensure plate gap dimension is set to appropriate gap setting. See Appendix X1 for recommendations on determining appropriate plate gap dimension settings.

9.2.2 Insert or otherwise place the pressurization and sensor nozzle inside the open end of the package.

9.2.3 Close the clamping mechanism to produce an air tight seal around the open end of the package including the area around the pressurization and sensor nozzle.

9.3 *Closed-Package Test:*

9.3.1 Insert the body of the package within the restraining plates and close the plates, if applicable, to the required plate gap dimension. See Appendix X1 for recommendations on determining appropriate plate gap dimension settings.

9.3.2 Carefully insert the pressurization and sensor nozzle entry device, and affix to the package so as to create an air tight seal. The center of the package is the preferred point of entry and may be fixtured as an attachment to the restraining plates (see Fig. 2).

9.4 Set the rate of pressurization and sensor sensitivity, if user selectable. Set the pressure failure sensor readout, if user selectable, to the desired units of measure, usually set to readout in pascal (Pa), kilopascal kPa), or inches of water units of measure for most package test resolutions required.

9.5 Begin test by initiating inflation process. Continue pressurization until a failure occurs. A failure in this context is when an area of the package ruptures (bursts) as the result of pressurization. The rupture (burst) is detected by the sensing mechanism as a rapid decrease in pressure within the body of the package, and the pressure reading device reports the pressure at the point in time just prior to the pressure drop.

9.6 Visually examine the tested package and note the position and type of failure, as well as the pressure at which the failure occurred. If the failure occurred in an area other than the seal the test may be voided depending on the purpose of the investigation.

10. Report

10.1 The report should include or have traceability to the following:

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