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Standard Test Methods for Gross Leakage of Liquids from Containers with Threaded or Lug-Style Closures[1]

This standard is issued under the fixed designation D 5094/D 5094M; 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 may demonstrate container/closure integrity with threaded or lug-style closures by the determination of gross leaks in rigid and semi-rigid containers (up to 4 L ~~(1.06 g).~~[1.06 g]. Such tests may be used to indicate the ability of a liquid container to survive the distribution environment without leaking. These test methods may not be suitable to determine the leak resistance of containers intended for transport of hazardous materials.

1.2 *Test Methods*:

1.2.1 *Test Method A, Shipping Container Vibration and Storage Test*, covers the ability of a shipping container and its interior packaging to protect the contents from leakage after transportation induced vibration and high-temperature storage.

1.2.2 *Test Method B, Shipping Container Vibration and Vacuum Chamber Test*, is suitable for individual containers and is usually less severe than Test Method A. The advantage of Test Method B is the shortness of the test.

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1.3 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.

1.4 *This standard does not purport to address the safety conserns 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:*[2]

D 996 Terminology of Packaging and Distribution Environments

D 999 Test Methods for Vibration Testing of Shipping Containers

D 3198 Test Method for Application and Removal Torque of Threaded or Lug-Style Closures

D 3474 Practice for ~~the~~ Calibration and Use of Torque Meters Used in Packaging Applications

D 4169 Practice for Performance Testing of Shipping Containers and Systems

D 4332 ~~Practice for Conditioning Containers, Packages, or Packaging Components for Testing~~ Practice for Conditioning Containers, Packages, or Packaging Components for Testing

D 7386 Practice for Performance Testing of Packages for Single Parcel Delivery Systems

3. Terminology

3.1 General definitions for packaging are found in Terminology D 996.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *gross leak*—any opening in the container or closure seal that produces visible leakage such that the container would not be suitable for transport or subsequent distribution.

3.2.2 *leak*—any opening in a container which, contrary to intention, either lets contents escape or permits substances to enter.

3.2.3 *leakage*—that which passes through a leak.

4. Summary of Test Methods

4.1 *Method A, Shipping Container Vibration and Storage Test*—Test specimens are filled to their expected fill capacity with

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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.

product or liquid simulating product and the closure is applied to the container. Closures should be applied with the same torque as would be encountered in production. The specimens are packed into shipping containers and vibrated. The specimens, stored on their sides, are subjected to 40°C ~~(104°F)~~[104°F] (or other conditions as appropriate) for four weeks. Each specimen is examined for leakage.

4.2 *Method B, Container Vibration and Vacuum Chamber Test*—Test specimens are partially filled with product or liquid simulating product and the closure is applied to the container. Closures should be applied with the same torque as would be encountered in production. The specimens are packed into shipping containers and vibrated. Following vibration, the individual specimens are removed from the shipping container and subjected to ~~10 in. Hg (33.7 kPa)~~–34 kPa [10 in. Hg] vacuum for 10 min and examined for leakage.

NOTE 1—Other levels of vacuum, or time, or both may be appropriate.

5. Significance and Use

5.1 These test methods are used to indicate the integrity of the container and closure system in the distribution environment.

5.2 These test methods measure the ability of the container and closure system to prevent leakage when stored or transported upright, inverted, or on the side.

5.3 These test methods allow for comparison of container/closure designs of threaded and lug-style closures of similar or different materials, or different manufacturers. These tests are suitable for packaging development, engineering and tooling evaluations.

6. Apparatus

6.1 *Method A, Shipping Container Vibration and Storage Test*:

6.1.1 *Drying Oven*, constant-temperature, equipped with means for ensuring adequate temperature control, 40 ± 1°C ~~(104~~[104 ± ~~1.8°F)~~1.8°F] and air circulation, ambient humidity, or other conditions as appropriate.

6.1.2 *Torque Meter*, with an appropriate scale which accurately measures within the expected torque range.

6.1.3 *Vibration Test Machine*, the apparatus described in the Apparatus section of Test Methods D 999 may be used.

6.2 *Method B, Shipping Container Vibration and Vacuum Test*:

6.2.1 *Vacuum Chamber*, any suitable chamber capable of withstanding approximately one atmosphere pressure differential, fitted with a vacuum-tight seal. A vacuum gauge, an inlet tube from a source of vacuum, and an outlet tube to the atmosphere shall be sealed to the chamber. The inlet and outlet tubes shall be equipped with shut-off valves. The vacuum gauge shall be laboratory quality with a full scale range of 0 to ~~30 in. Hg (0 –100 kPa [0 to 100 kPa). 30 in. Hg].~~

6.2.2 *Torque Meter*, with an appropriate scale which accurately measures within the expected torque range.

6.2.3 *Vibration Test Machine*, the apparatus described in the Apparatus section of Test Methods D 999 may be used.

7. Sampling

7.1 The complete test unit shall consist of the shipping container, with interior packaging and the actual test specimens (container(s) and closure(s)).

7.2 A minimum of three specimens representing each variable, such as cap or bottle mold from each cavity but not less than ten specimens are to be selected. The total number of specimens may need to be increased to completely fill the shipping container. More than one shipping container may be required.

7.3 Select unused closures and unused containers that are within specifications.

8. Test Specimens

8.1 *Test Method A*—A specimen shall be one container filled to expected fill capacity with product or liquid simulating product. The closure is secured in accordance with 11.1.

8.2 *Test Method B*—A specimen shall be one container one-third filled with product or liquid simulating product. The closure is secured in accordance with 11.1.

8.3 Colorant should be added to the contents when necessary to give permanent indication where there is leakage.

9. Calibration

9.1 Calibrate the torque meter in accordance with Practice D 3474.

10. Conditioning

10.1 Store the shipping container components at ambient laboratory conditions for at least 4 h before testing, or other conditions in accordance with Practice D 4332.

10.2 Store the torqued container/closure test specimens upright at least 24 h at ambient conditions before commencing the test.

11. Procedure

11.1 Apply closures to the containers according to the Application Torque Measurement section of the procedure in Test Method D 3198.