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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Test Method for Simulated Drop of Loaded Containers by Shock Machines[1]

This standard is issued under the fixed designation D 5487; 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 general procedures of using shock machines to replicate the effects of vertical drops of loaded shipping containers, cylindrical containers, and bags and sacks.

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 996 Terminology of Packaging and Distribution Environments[2]

D 999 Test Methods for Vibration Testing of Shipping Containers[2]

D 3332 Test Methods for Mechanical-Shock Fragility of Products Using Shock Machines[2]

D 4332 Practice for Conditioning Containers, Packages, or Packaging Components for Testing[2]

D 5276 Test Method for Drop Test of Loaded Containers by Free Fall[2]

E 122 Practice for Choice of Sample Size to Estimate the Average Quality of a Lot or Process[3]

3. Terminology

3.1 General terms for packaging and distribution environments are found in Terminology D 996.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *critical element*—the most fragile component of the test specimen.[4]

3.2.2 *shock pulse programmer*—a device used to control the parameters of the shock pulse and shape of the pulse generated by the shock test machine.

3.2.3 *shock test machine drop height*—the distance through which the carriage of the shock test machine free falls before striking the shock pulse programmer.

3.2.4 *velocity*—the rate of change of position of a body in a specified direction with respect to time, measured in inches per second or metres per second.

4. Significance and Use

4.1 Shipping containers and the interior packaging materials are used to protect their contents from the hazards encountered in handling, transportation, and storage. Shock is one of the more troublesome of these hazards. Free-fall drop testing, while easy to perform, often understresses the test specimen by subjecting it to drops which are not perpendicular to the dropping surface.

NOTE 1—For example, testing has shown that non-perpendicular drops, 2° off perpendicularity, result in 8 % lower acceleration into the test specimen resulting from the impact energy dispersing in several axes.[5]

4.1.1 Controlled shock input by shock machines provides a convenient method for evaluating the ability of shipping containers, interior packaging materials, and contents to withstand shocks. Simulated free-fall drop testing of package systems, which have critical elements, has produced good results where the frequency of the shock pulse is at least three times that of the package system's natural frequency.

4.2 As in most mechanical shock test procedures, fixturing of the package on the shock test machine may have significant influence on the test results. Typically, packages will be firmly held on the table by securing some type of cross member(s) across the top of the package. Care should be taken that any pressure resulting from such fixturing should be minimal, particularly when the container being tested is corrugated or some other similar material.

4.2.1 In cases where low-acceleration, long-duration responses are anticipated, any fixturing can potentially influence packaged item response and can possibly alter any correlation between this test method and free-fall drop testing. Where such correlation is desired, the package can be tested without it being fixed directly to the table. Note that in such circumstances, the shipping container can vigorously rebound from the table and can, if not otherwise controlled, present a safety problem for operators. Fixing the shipping container to the shock machine table is most often recommended for safety and

[1] This test method is under the jurisdiction of ASTM Committee D-10 on Packaging and is the direct responsibility of Subcommittee D10.22 on Physical Test Methods.

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

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

[4] Robert E. Newton, Fragility Assessment Theory and Test Procedures, U. Naval Postgraduate School, Monterey, California.

[5] Fiedler, Robert M. and Fanfu Li, *A Study of the Effects of Impact Angles on the Shock Levels Experienced by Packaged Products*, MTS Systems Corporation. On file at ASTM. Request RR:D10-1008.