Designation: D642 – 00(Reapproved 2010)

Standard Test Method for Determining Compressive Resistance of Shipping Containers, Components, and Unit Loads[1]

This standard is issued under the fixed designation D642; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This test method covers compression tests on shipping containers (for example, boxes and drums) or components, or both. Shipping containers may be tested with or without contents. The procedure may be used for measuring the ability of the container to resist external compressive loads applied to its faces, to diagonally opposite edges, or to corners (Fig. 1 and Fig. 2). This test method covers testing of multiple containers or unit loads, in addition to individual shipping containers, components, materials, or combination thereof.

1.2 The test method of applying load may be used to compare the characteristics of a given design of container with a standard, or to compare the characteristics of containers differing in construction.

1.3 This test method is related to TAPPI T804, which is similar for fixed platen machines but does not recognize swivel platen machines. This test method fulfills the requirements of International Organization for Standardization (ISO) Test Method 12048. The ISO standards may not meet the requirements for this test method.

1.4 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.5 *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:*[2]

D644 Test Method for Moisture Content of Paper and Paperboard by Oven Drying (Withdrawn 2010)[3]

D996 Terminology of Packaging and Distribution Environments

D2016 Methods of Test for Moisture Content of Wood (Withdrawn 1987)[3]

D4169 Practice for Performance Testing of Shipping Containers and Systems

D4332 Practice for Conditioning Containers, Packages, or Packaging Components for Testing

D4577 Test Method for Compression Resistance of a Container Under Constant Load

E4 Practices for Force Verification of Testing Machines

E122 Practice for Calculating Sample Size to Estimate, With Specified Precision, the Average for a Characteristic of a Lot or Process

2.2 *TAPPI Standard:*

T 804 Compression testing of fiberboard shipping containers[4]

2.3 *ISO Standard:*

ISO 12048 Packaging—Complete, filled transport packages—Compression and stacking test using compression tester[5]

3. Terminology

3.1 *Definitions*—General terms for Packaging and Distribution Environments are found in Terminology D996.

[1] This test method is under the jurisdiction of ASTM Committee D10 on Packaging and is the direct responsibility of Subcommittee D10.21 on Shipping Containers and Systems - Application of Performance Test Methods.

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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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from the Technical Association of the Pulp and Paper Industry, 15 Technology Parkway South, Atlanta, GA 30092.

[5] Available from American National Standards Institute, 25 W. 43rd St., 4th Floor, New York, NY 10036.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *fixed platen testing machine*—a testing machine equipped with two platens which are both restrained from tilting.

3.2.2 *swiveled platen testing machine*—a testing machine equipped with two platens, one rigidly restrained from tilting while the other platen is universally mounted and allowed to tilt freely.

4. Significance and Use

4.1 Compressive resistance is one of the properties used to evaluate the ability of shipping containers, components, and unit loads to successfully survive the compressive forces they are subjected to during storage and distribution (see Note 1).

NOTE 1—For constant load test refer to Test Method D4577.

4.2 Compressive resistance may be determined with either fixed- or swiveled-platen-type testing machines. However, a fixed-head compression machine is required to perform edge-to-edge and corner-to-corner orientations on test specimens (see Note 2). Also, unit loads are generally tested only in the top-to-bottom orientation.

NOTE 2—Fixed-platen machines generally cause specimens to fail at their strongest point, while swivel-platen machines cause specimens to fail at their weakest point.[6] The swiveled platen is allowed to move to the weakest point of the container.

5. Apparatus

5.1 *Compression Testing Machines:*

5.1.1 *Fixed-Platen Testing Machine*—Two platens, flat to within 0.01 in. (0.25 mm) for each 12 in. (304.8 mm) in length, and one of which is movable in the vertical direction so as to compress the container between the platens. One is the load measuring platen, and both should be of sufficient size so that the test container does not extend beyond the edges of the platens. Both platens are fixed in the horizontal directions so as to have no lateral movement greater than0.05 in. (1.3 mm), and are held parallel throughout the test to within 0.04 in. (1 mm) for each 12 in. (304.8 mm) in the length and width dimensions.

5.1.2 *Swivel-Platen Testing Machine*—Two platens, flat to within 0.01 in. (0.25 mm) for each 12 in. (304.8 mm) in length, and one which is movable in the vertical direction so as to compress the container between the platens. One is the load-measuring platen, and both should be of sufficient size so that the test container does not extend beyond the edges of the platens. One platen is fixed in the horizontal direction so as to have no lateral movement greater than 0.05 in. (1.3 mm). The second platen is attached to the machine by a swivel or universal joint to a point directly centered on the platen, allowing the platen to tilt freely.

5.2 *Suitable Closure Apparatus* —See Appendix X1.

5.3 *Conditioning Apparatus*—Provide adequate facilities for conditioning test containers at proper relative humidity and temperature prior to test in accordance with the requirements of the specifications covering the containers to be tested. It is recommended that the atmospheres for conditioning be selected from those shown in Practice D4332. Unless otherwise specified, fiberboard and other paperboard containers shall be preconditioned and conditioned in accordance with the standard atmosphere specified in Practice D4332.

6. Sampling, Test Specimens, and Test Units

6.1 Choose test specimens and sample quantities to provide an adequate determination of representative performance. For large production runs, lot sampling is advised. Application of Practice E122 is suggested.

6.2 Whenever sufficient containers and contents are available, it is recommended that five or more replicate tests be conducted to improve the statistical reliability of the data obtained.

6.3 The specimens being tested shall be complete in all respects. Depending on the purpose of the test, interior components may or may not be included. Tests shall be made on specimens with or without contents as prescribed.

6.4 The test specimen shall be closed and secured in the same manner as will be used in preparing them for shipment unless otherwise specified. The method of flap securement for corrugated containers may affect test results (see Appendix X1).

7. Calibration and Standardization

7.1 The accuracy of the test equipment must be verified to ensure reliable test data.

7.1.1 The overall system accuracy of the recorded or indicated applied load (force) shall be verified in accordance with Practice E4. The verified loading range shall be specified, and errors within the loading range shall not exceed ±1.0 % of reading (as calculated in Practice E4). If testing below the Practice E4 verified loading range is desired, then the maximum permissible error shall not exceed ±0.2 % of the full range of the force sensor. Calculate as follows:

$$E = F_S \times 0.002 \quad (1)$$

where:

E = maximum permissible error, lbf or N, and
F_S = force sensor's full range, lbf or N.

7.1.2 The accuracy of the *recorded or indicated* platen displacement must be verified in accordance with the equipment manufacturer's recommended procedures. The error, including the effects of any backlash in the loading system, shall not exceed ±0.1 in. (±2.5 mm).

7.1.3 The accuracy of the platen travel rate at 0.5 in./min (12.7 mm/min) must be verified throughout each loading range in accordance with the equipment manufacturer's recommended procedures. The error, including any backlash in the loading system, shall not exceed ±0.10 in./min (±2.5 mm/min).

8. Conditioning

8.1 Test specimens shall be conditioned prior to test or during test, or both, in accordance with the requirements of the

[6] Singh, S. P., Burgess, G., Langlois, M., "Compression of Single-Wall Corrugated Shipping Containers Using Fixed and Floating Test Platens," *ASTM JOTE*, July 1992.