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WORKING GROUP
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SUBJECT
CATEGORY
Fiscotec (Fiberboard Shipping Container Testing)

RELATED
METHODS_____ See "Additional Information"

CAUTION:

This Test Method may include safety precautions which are believed to be appropriate at the time of publication of the method. The intent of these is to alert the user of the method to safety issues related to such use. The user is responsible for determining that the safety precautions are complete and are appropriate to their use of the method, and for ensuring that suitable safety practices have not changed since publication of the method. This method may require the use, disposal, or both, of chemicals which may present serious health hazards to humans. Procedures for the handling of such substances are set forth on Safety Data Sheets which must be developed by all manufacturers and importers of potentially hazardous chemicals and maintained by all distributors of potentially hazardous chemicals. Prior to the use of this method, the user must determine whether any of the chemicals to be used or disposed of are potentially hazardous and, if so, must follow strictly the procedures specified by both the manufacturer, as well as local, state, and federal authorities for safe use and disposal of these chemicals.

Drum Test for Fiberboard Shipping Containers (Revolving Hexagonal Drum) *(Ten-year review of Classical Method T 800 cm-16)*

1. Scope

1.1 This method describes two procedures for testing loaded fiberboard shipping containers by means of a revolving drum tester.

1.1.1 *Procedure A:* to determine the ability of the container to withstand rough handling by subjecting it to a variety of shocks and impact stresses simulating those which may be expected in some handling and shipping cycles, and

1.1.2 *Procedure B:* to determine the relative ability of a package (shipping container and interior packaging material, if any) to provide protection to its contents when subjected to a variety of shocks and impact stresses simulating some handling and shipping conditions.

1.2 The procedures described in this method are for a 2.13-m (7-ft) (internal dimensions at intersection of faces) revolving hexagonal drum and may be used to test containers whose gross weight does not exceed 113 kg (250 lb), and whose maximum dimension does not exceed 510 mm (20 in.). This drum is unsuitable for containers

exceeding the above size or for shapes that do not move and fall freely when the drum is rotated.

1.3 Also in use is a 4.27-m (14-ft) diameter drum, described in ASTM D 782. It is rarely used for containers whose greatest dimension is less than 510 mm (20 in.). It is used for testing containers whose weight does not exceed 272 kg (600 lb) and whose greatest dimension does not exceed 1020 mm (40 in.).

NOTE 1: The drum test is best suited to obtain the net effect of an unpredictable variety or random combination of shocks and stresses. When the effects of specific types of shocks and stresses are to be determined or isolated, consideration should be given to using another method which provides definite control of the cycle of events, such as the incline impact test TAPPI T 801 "Impact Resistance of Fiberboard Shipping Containers" or TAPPI T 802 "Drop Test for Fiberboard Shipping Containers."

2. Summary

The revolving drum subjects the container and its contents to a series of random falls onto the inner faces of the drum and against the baffles arranged around the inner periphery of the drum. The baffles are designed to cause the container to fall on different corners, edges, and faces and to present various impact hazards.

3. Significance

3.1 The drum test is usually made to compare various container designs of the same size for carrying the same load by simulating an unpredictable, uncontrolled type of rough handling expected in actual shipment as, for example, when packages are handled individually. The test permits observing the progressive destruction or failure of the container and interior packaging material and aids in making improvements to their design.

3.2 The series of falls is unpredictable; probably no two containers will fall or tumble in exactly the same sequence. Hence, the drum test results may be expected to vary more than the results of a test not containing this random characteristic (see Section 9, Precision).

3.3 Comparative tests between containers of substantially different proportions or dimensions (even if of the same weight and carrying the same contents) are not reliable because of the difference of the action in the drum, height of fall, etc.

4. Apparatus

4.1 *Testing machine*, consisting of the following components:

4.1.1 *Revolving drum* (see Fig. 1), in the form of a prism whose bases are regular hexagons and whose lateral faces are rectangles. The axis of rotation is horizontal. The drum rotates at $2 \pm \frac{1}{6}$ rpm. Faces and rigidity of structural members conform to the approved drawings of the USDA Forest Products Laboratory (see Appendix A.1).



Fig. 1. Testing drum.

4.1.2 *Baffles or hazards* fixed on the inside faces of the drum. Location and construction of baffles conform

to the approved drawings of the USDA Forest Products Laboratory (see Appendix A.1). The inner faces and hazards are kept smooth, clean, polished, and in good repair so that if an ordinary No. 2½ food can (“packers” 410 x 411) or the equivalent, filled with water, with a gross weight of 950 ± 45 g (2.1 ± 0.1 lb) rests on its bottom on the drum face, it will just slide when the face is at an angle of $15 \pm 2^\circ$ from the horizontal.

NOTE 2: When prescribed for a specific test, a conical projection may be positioned on one face of the drum to simulate a puncture hazard. Its use is to be prominently noted in the report.

4.1.3 *Automatic counting device*, to record each individual fall as each drum face passes the counter.

5. Test specimens

5.1 Obtain at least five, and preferably ten or more, containers.

5.2 When containers are being tested for their resistance to breaking open, pack them either (1) with the contents for which they are designed, or (2) with a designated dummy load (for example, cans filled with water or with asphalt). When testing for the protection of the contents pack and seal the containers as they are designed to be shipped.

5.3 Identify the faces, edges and corners of the container as follows: facing one end (for fiberboard regular slotted containers with manufacturer's joint on the observer's right), the top of the container is designated as 1, the right side as 2, the bottom as 3, the left side as 4, the near end as 5, and the far end as 6. Each edge is identified by the numbers of the two faces which form that edge; for example, 1-2 identifies the edge where the top and right side meet, and 2-5 the edge formed by the right side and the near end. Each corner is identified by the number of the three faces which meet to form that corner; for example, 1-2-6 identifies the corner where the top, the right side, and the far end meet.

6. Conditioning

6.1 Condition the containers in accordance with TAPPI T 402 “Standard Conditioning and Testing Atmospheres for Paper, Board, Pulp Handsheets, and Related Products,” until there is no significant change in weight between successive weighings taken at reasonable intervals, e.g., 30 min. Ensure that the conditioning atmosphere has free access to all surfaces of the empty boxes or their component parts and to all outer surfaces where the container is filled.

6.2 Depending on the purpose of the test, the containers may be conditioned prior to the drum tests by a different physical test or exposure to water or other atmospheric conditions when so stated.

7. Procedures

7.1 *Procedure A: to determine the ability of a container to withstand rough handling.*

7.1.1 Make a record of the container's conditioning and of its state prior to testing. Start the test with a single container placed in the crotch of the hazard of face No. 1 of the drum, with container face No. 1 (top) up, with end No. 5 and side No. 2 against the sides of the hazard, and with end No. 5 facing the front of the drum. Start the drum in motion. As the drum revolves, the container will slide, tumble, and fall against the guides and hazards of the inside faces of the drum. As the test continues, make a written record of the damage to the container, such as skewing, puncture, tears, or splits. The drum may be stopped at any time during the test to permit a closer inspection. Movement of the container from one drum face to the next is counted as one fall.

7.1.2 Record the number of falls sustained by the container up to the time of occurrence of any damage, and describe the damage, identifying the faces, corners, and edges as given in the preceding section.

7.1.3 Continue the test to an end point (examples given in Appendix A.2), recording the various stages of failure or damage (examples given in Appendix A.3).

NOTE 3: Special situations may call for some other special condition to be stated as final failure to permit valid comparison of data.

7.2 *Procedure B: to determine the ability of a container to provide protection to its contents.*

7.2.1 After a predetermined number of falls (see Additional information 11.3), open the container and inspect the condition of the contents and the blocking or packing material. If the container is closed and placed again

in the drum for further testing, put it in the same position as when it was withdrawn.

7.2.2 The end point of this test is determined by prearranged objectives. This may be after 6, 12, 24, or any other specified number of falls or when evidence of damage is detected by leakage, noise, etc.

8. Report

8.1 Include the following in reporting the results of either Procedure A or B:

8.1.1 Complete description and specification of the containers tested, including type, style, material, and dimensions; description of any blocking or cushioning (inner packing), if used.

8.1.2 Complete description of contents, including arrangement and fit.

8.1.3 Gross weight and weight of contents, including packing material.

8.1.4 Method of sealing the container.

8.1.5 Conditioning, procedure, and condition of each container at the beginning of the test.

8.1.6 Detailed record of the test of each container, including a description of any damage and when it occurred.

8.1.7 Any other observations which may assist in correctly interpreting the results of the test or in improving the design or construction of the container.

8.1.8 A statement to the effect that all tests were made in full compliance with this method, or that the method was used with certain specific exceptions, for example, that the puncture hazard was used.

9. Precision

9.1 Values for a precision statement cannot practicably be determined.

9.2 This test is subject to a high degree of variation. Its most effective use is limited to ascertaining the relative performance between containers in the same drum under the same conditions. Agreement between observers, to ensure uniformity in determining end points and evaluation of damage, is essential. When results of tests in more than one drum are compared, sufficient tests to determine the correlation between them are necessary to develop consistent average values.

9.3 The number of falls that similar containers withstand in successive tests usually varies over a wide range, attributable to the chance series of falls, the chance orientation of the container throughout the test, and the resulting different cycles of abuse.

9.4 In consequence, the reproducibility of test results between tests in the same drum, or especially in different drums, as measured by the number of falls with a practical number of test specimens, is of low precision.

10. Keywords

Fiberboards, Container boards, Containers, Container testing

11. Additional information

11.1 Effective date of issue: To Be Assigned.

11.2 This method was first published in 1944 as a Suggested Method. It was revised in 1950 and 1964 and became an Official Method in 1975. It was reclassified as classical in 1988 and revised in 1996.

11.3 The following formula has been suggested to assist in deciding the approximate number of falls for fiberboard containers to run the test for Procedure B, i.e., for measuring the ability of the container to provide protection of its contents:

$$\text{Number of falls} = \frac{(57 - \text{gross weight in kg})}{(0.57 \times \text{ratio of greatest to least dimension})}$$

or, until failure as described in Procedure A occurs, or until breakage of the contents is evident (as in the spilling of liquids), whichever occurs first.

11.4 Test results from three groups of five boxes with a common failure point of "contents spilled" gave

an average repeatability of 23%.

11.5 Related method: ASTM D 782 “Shipping Containers in Revolving Hexagonal Drum,” American Society for Testing and Materials, Philadelphia, PA.

References

1. Newland, J. A., and Wilson, T. R. C., “Development of a Box-Testing Machine and Some Results of Test,” *ASTM Proceedings* **16**, Part 2, 320 (1916).

Appendix A.1: Approved drawings

To obtain approved drawings for the testing drum, write to the U.S. Department of Agriculture, Forest Products Laboratory, Madison, WI 53705. Request Drawing No. 248, Sheet 1, dated March 30, 1948; Sheet 2, revision dated September 30, 1955.

Appendix A.2: Suggested typical examples of end points or failures

- A.2.1 Failure of the container (rupture).
- A.2.2 Any part of the contents can be removed without further damage to the container.
- A.2.3 Partial or complete spillage of the contents.
- A.2.4 Predetermined type of damage to the container.
- A.2.5 Predetermined number of falls.

Appendix A.3: Typical stages of failure or damage to be observed for fiberboard shipping containers

- A.3.1 First 25-mm (1-in.) cut.
- A.3.2 First 152-mm (6-in.) cut.
- A.3.3 Tear or rupture joining two opposite edges.

Your comments and suggestions on this procedure are earnestly requested and should be sent to the TAPPI Standards Department.

