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Standard Test Method for Drop Test for Loaded Boxes¹

This standard is issued under the fixed designation D 775; 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 four procedures for the drop testing of loaded boxes.

1.2 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

D 644 Test Method for Moisture Content of Paper and Paperboard by Oven Drying²

D 685 Method for Conditioning Paper and Paper Products for Testing²

D 880 Method for Incline Impact Test for Shipping Containers²

D 997 Method for Drop Test for Loaded Cylindrical Containers²

D 1083 Method of Testing Mechanical Handling of Unitized Loads and Large Shipping Cases and Crates²

E 122 Recommended Practice for Choice of Sample Size to Estimate the Average Quality of a Lot or Process³

3. Significance and Use

3.1 This test method is used to provide an indication of the ability of a box to withstand the damage which can be caused by the sudden shock induced by dropping a package. It simulates those shocks that are likely to occur in the handling of packages through a variety of distributions cycles and the ability of the box to protect the contents against these shocks. The test may also permit observation of progressive failure of the box and damage to the contents.

3.2 Drop tests are performed with either of the two following objectives (see Annex A1), either objective being of value for comparing the characteristics of a package design to a standard or for comparing differences in package construction:

3.2.1 *Objective A*—To measure the ability of the shipping container to withstand rough handling.

3.2.2 *Objective B*—To measure the ability of the package (shipping container and interior packing materials) to protect its contents.

3.3 These procedures are also particularly suitable for boxes that are normally handled manually. Boxes of such bulk or mass that they cannot be handled manually may be more satisfactorily tested in accordance with Methods D 880 and D 1083.

4. Apparatus

4.1 *Drop Test Apparatus*—The drop test equipment shall conform to the following requirements:

4.1.1 Permit the box to be placed in a position, prior to release, that will assure correct orientation, within 2° for flat-face drops and 10° for edge and corner drops upon impact.

4.1.2 Permit accurate control of the drop from specified heights.

4.1.3 Utilize lifting devices that will not damage the test member.

4.1.4 Provide a release mechanism that does not impart rotational or side-wise forces to the test package. If drop leaves are used, the apparatus shall provide a spring or other mechanism so that the leaves do not interfere with a free, unobstructed fall.

4.1.5 Provide a rigid and level dropping surface that is integral with a mass that shall be at least 50 times the weight of the dropping container. Neither the depth nor width of the mass shall be less than half the length. The dropping surface, firmly anchored to the mass, shall be a steel plate not less than 1/2 in. (13 mm) thick.

4.1.6 A test unit for calibration purposes should be constructed. It shall be of the same general size and mass as maximum size and mass packages to be tested, and shall be dropped from heights in the expected range. The center or gravity of the unit shall be at its geometric center. When this unit is dropped, it must strike the impact surface within the specified limits. Compliance with the specifications may conveniently be determined with a camera.

4.1.7 For very large packages it may be necessary to use a hoist, sling, and tripping devices or solenoid operated drop test mechanism and suspension devices shown in Figs. A1–A4 of Method D 997.

4.2 *Conditioning Apparatus*—Adequate facilities shall be provided for conditioning test specimens at proper humidity and temperature prior to test in accordance with the specifications covering the containers to be tested.

5. Sampling

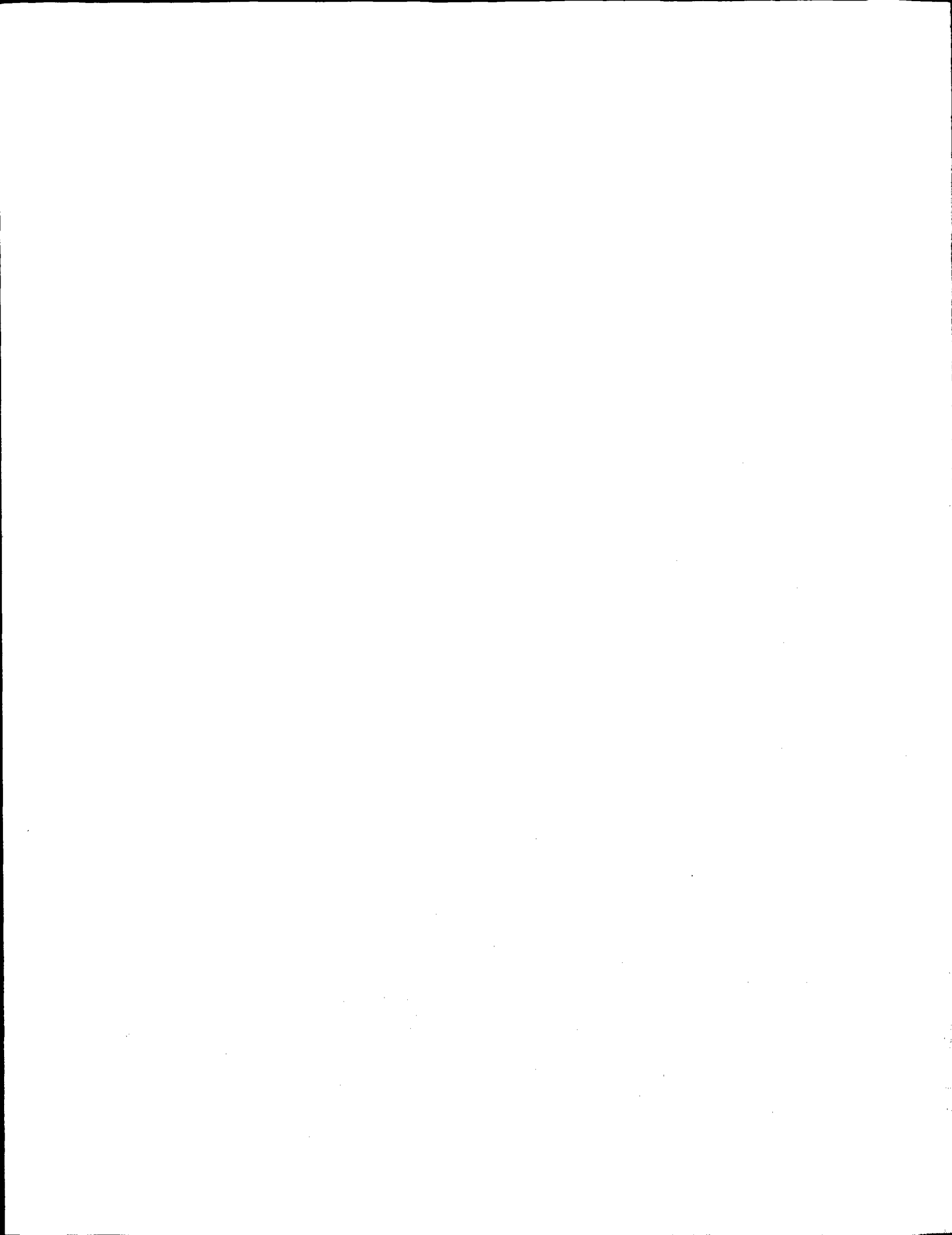
5.1 Determine the number of specimens to be tested in accordance with Recommended Practice E 122.

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 Handling and Transportation.

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

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



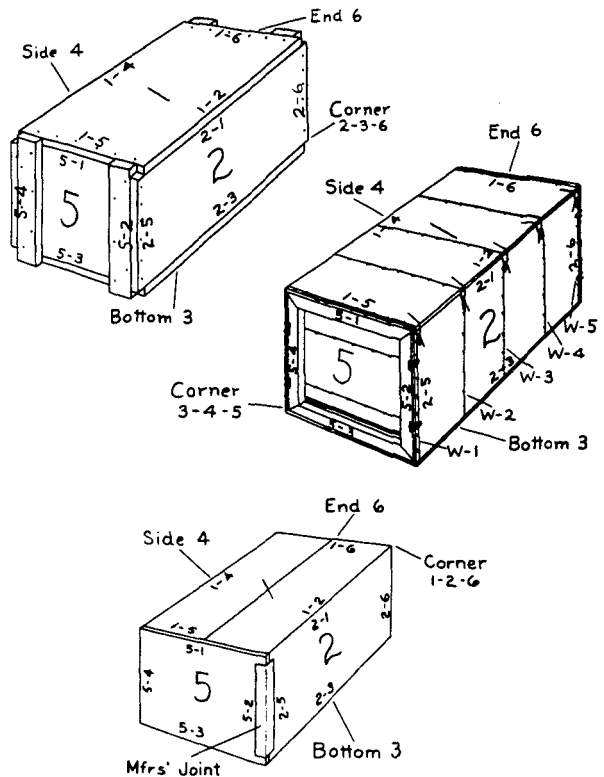


FIG. 1 Diagram Showing Identification of Faces, Edges, and Corners of Containers

6. Test Specimens

6.1 When the protective ability of the package is to be evaluated, pack the package with the actual contents for which it was designed (Note 1). When the ability of the box to withstand rough handling is to be evaluated, pack the box with either the actual contents or with a load simulating the contents. Regardless of which procedure is used, close and strap the container in the same manner that will be used in preparing it for shipment.

NOTE 1—Where the use of actual contents is prohibitive because of excessive cost or danger, a “dummy” load simulating the contents with respect to dimensions, center of gravity, moment of inertia, etc., may be used with accelerometers or other indicating mechanisms.

6.2 The procedure for identification of the faces, edges, and corners of box shall be as follows (see Fig. 1): Facing one end of the box with the manufacturer’s joint on the observer’s right if the container is fiberboard, designate the top of the box 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. Identify the edges by the numbers of the two faces that form that edge: for example, 1-2 identifies the edge formed by the top and the right side, and 2-5 the edge formed by the right side and near end. (The latter is the edge having the manufacturer’s joint, in fiberboard container.) Identify the corners by the numbers of the three faces that meet to form that corner; for example, 1-2-6 identifies the corner where the top, the right side, and the far end meet.

7. Conditioning

7.1 Depending on the purpose of the tests, the boxes may be conditioned prior to the drop test by either a different

physical test, water immersion, exposure to water spray, or exposure to standard or other fixed conditions of air temperature or humidity. Fiberboard boxes shall be conditioned in accordance with Method D 685.

8. Procedure

8.1 Perform the tests in the conditioned atmosphere or immediately upon removal from that atmosphere.

8.2 Drop test procedures may be conducted by dropping the package either on one member of the box or on several different members in a prescribed sequence (cycle testing). A member is defined as a face, corner, or edge of the box.

8.2.1 When the box is to be dropped on a face, position it so that upon impact, there is no more than a 2° angle between the plane of this face and the dropping surface.

8.2.2 When the box is to be dropped on an edge, position it so that upon impact, this edge makes no more than 2° angle with the dropping surface, and the plane containing this edge and the center of gravity of the box makes no more than a 10° angle with the vertical.

8.2.3 When the box is to be dropped on a corner, position it so that upon impact, the line containing this corner and the center of gravity of the box makes no more than a 10° angle with the vertical.

8.3 Choice of End Point—In conducting drop tests, use either of two types of end points: (1) continue the test until obvious damage occurs, or (2) conduct the test at a specified number of drops or cycles followed by examination of the resulting damage to the contents or the box (depending upon which objective, A or B, is being considered (see Annex A1)).

8.4 Height of Drop—The height from which the box shall be dropped will depend upon the purpose of the test. In some instances the height and number of drops will be prescribed in the specifications for the box. For end points based upon obvious damage, choose the height of drop as a height judged to be sufficient to cause failure to any of the boxes of a comparison series within a reasonable and convenient number of falls, but also that will not cause failure to any of the samples in less than five falls. If the approximate drop resistance of the boxes is unknown, determine this height by preliminary tests. If the end point is a prescribed number of drops, then choose the height of drop by consideration of the expected shipment hazards. In the single zone drop procedure (8.10) the height of drop is determined, as the test progresses, from previous drops.

8.5 In a comparison series where a number of different samples are to be compared use the following procedure: Test one of the specimens of the first sample, chosen at random, followed by the testing of a randomly chosen specimen of each of the other samples until one specimen from each sample has been tested. Follow the same procedure with the remaining specimens of the various samples.

8.6 After the purpose of the test has been designated, select the procedure from those in 8.7, 8.8, 8.9, or 8.10 and after consulting the outline in Annex A1 to see which procedures are applicable. The outline will serve as a standard code for completely describing the method chosen.

8.7 Constant-Height Drop Test—The procedure for the constant-height drop test consists of repeatedly dropping the test package from one higher until the end point of the test is reached.