Designation: D5265 – 09 (Reapproved 2016)

Standard Test Method for Bridge Impact Testing[1]

This standard is issued under the fixed designation D5265; 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 is intended to determine the capability of a long package with a narrow cross-section to resist impact near its center when the package is supported only at its ends. This test method allows the user to select from two test options: Option A employs the use of a free-fall drop tester (see Exhibit B), and Option B employs the use of simulated mechanical impact testing equipment (S.M.I.T.E.; see Exhibit A). The two optional procedures are designed to impart the same amount of kinetic energy at impact; therefore, each procedure yields equal damage-producing potential.

1.2 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.

1.3 *This standard does not purport to address all of the safety problems, 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D644 Test Method for Moisture Content of Paper and Paperboard by Oven Drying (Withdrawn 2010)[3]

D685 Practice for Conditioning Paper and Paper Products for Testing

D996 Terminology of Packaging and Distribution Environments

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

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

3. Terminology

3.1 *Definitions*—The terms and definitions used in this test method may be found in Terminology D996.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *elongated package*—a package that is long in proportion to width and thickness, with lengths greater or equal to 36 in. (914 mm) and each of the other two dimensions 20 % or less of the longest dimension.

4. Significance and Use

4.1 Materials shipped in elongated packages are liable to damage as a result of impact near their midpoint when only the ends are supported. This type of damage can occur during the shipment of packaging of mixed dimensions. It is particularly prevalent during conveyer line transport and sortation. This test method provides a means of determining resistance to such damage.

5. Apparatus

5.1 *Option A—Free-Fall Drop Tester,* conforming to the conditions specified in 10.2.1 (see Fig. 1).

5.1.1 *Impactor,* composed of a hardwood, with a mass of 9 ± 0.4 lb (4.1 ± 0.2 kg_w) and dimensions of 12 × 12 × 12 in. (300 × 300 × 300 mm). The impactor shall have at least one bottom edge covered by angle iron. The box shall be filled with the specified weight and void fill to keep the weight in place.

5.1.2 *Support Blocks,* made from hardwood, nominal 6 × 6 in. (150 × 150 mm), long enough to support the full width of the largest package to be tested.

5.2 *Option B*—Commercial S.M.I.T.E. Tester, using a guided impactor and velocity meter to calculate the theoretical free-fall drop of the missile (see Fig. 2).

5.2.1 *S.M.I.T.E. Tester Impactor (missile),* fabricated in a V-shape cross-section from a steel flat plate, with a mass of 50 ± 0.4 lb (22.68 ± 0.2 kg_w) and length of approximately 30 in. (760 mm). The long edges of the missile shall be rounded to a radius of 0.25 ± 0.0625 in. (6 ± 2 mm).

NOTE 1—The standard S.M.I.T.E. tester is equipped with a variety of interchangeable missiles, providing impact options ranging from flat drop,

[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.

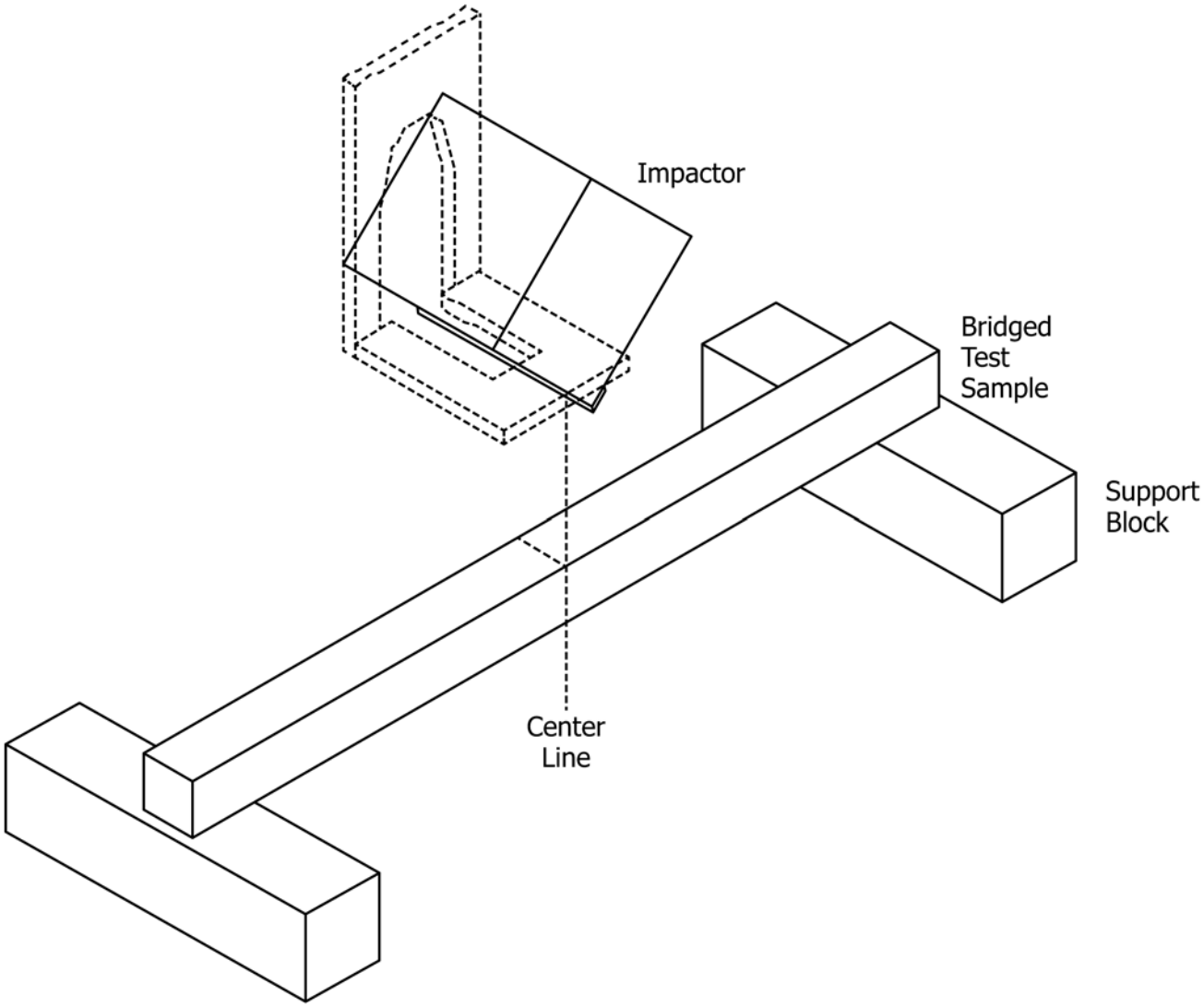

FIG. 1 Vertical Drop Tester

angle edge drop, half round, half ball, and corner. The total missile assembly, regardless of which face is used, will weigh 50 lb (22.68 kg). Knowing this, the mass of a S.M.I.T.E. tester is always 50 lb (22.68 kg).

5.2.2 *Support Blocks,* made from hardwood, nominal 6 × 6 in. (150 × 150 mm), long enough to support the full width of the largest package to be tested.

6. Sampling

6.1 The test specimens and number of samples shall be chosen to permit an adequate determination of representative performance. For large production runs, lot sampling for quality control in accordance with Practice E122 is advised.

6.2 In the absence of any sampling plan, at least three representative specimens should be selected for performance evaluation.

7. Test Specimens

7.1 When the protective capability of a package is to be evaluated, it is preferable to pack the package with the actual contents for which it was designed (Note 2). When the capability of a box to withstand rough handling is to be evaluated, pack the container with either the actual contents or a load simulating the contents. Regardless of which procedure is used, close the container in the same manner that will be used in preparing it for shipment.

NOTE 2—Where the use of actual contents is not feasible because of excessive cost or danger, a dummy load simulating the contents with respect to dimensions, center of gravity, moment of inertia, density, flow characteristics, etc. shall be used.

7.2 When comparing the performance of various elongated package designs, it is preferable to test empty erected cartons, which are closed and sealed in the same manner that will be used in preparing it for shipment.

7.3 Close and seal the container in the normal manner. Dry and age sufficiently so that any adhesive, protective coatings, sealing tape, etc. will have reached their final normal condition.

8. Conditioning

8.1 Depending on the purpose of the tests, packages may be conditioned prior to the bridge impact test by either a different

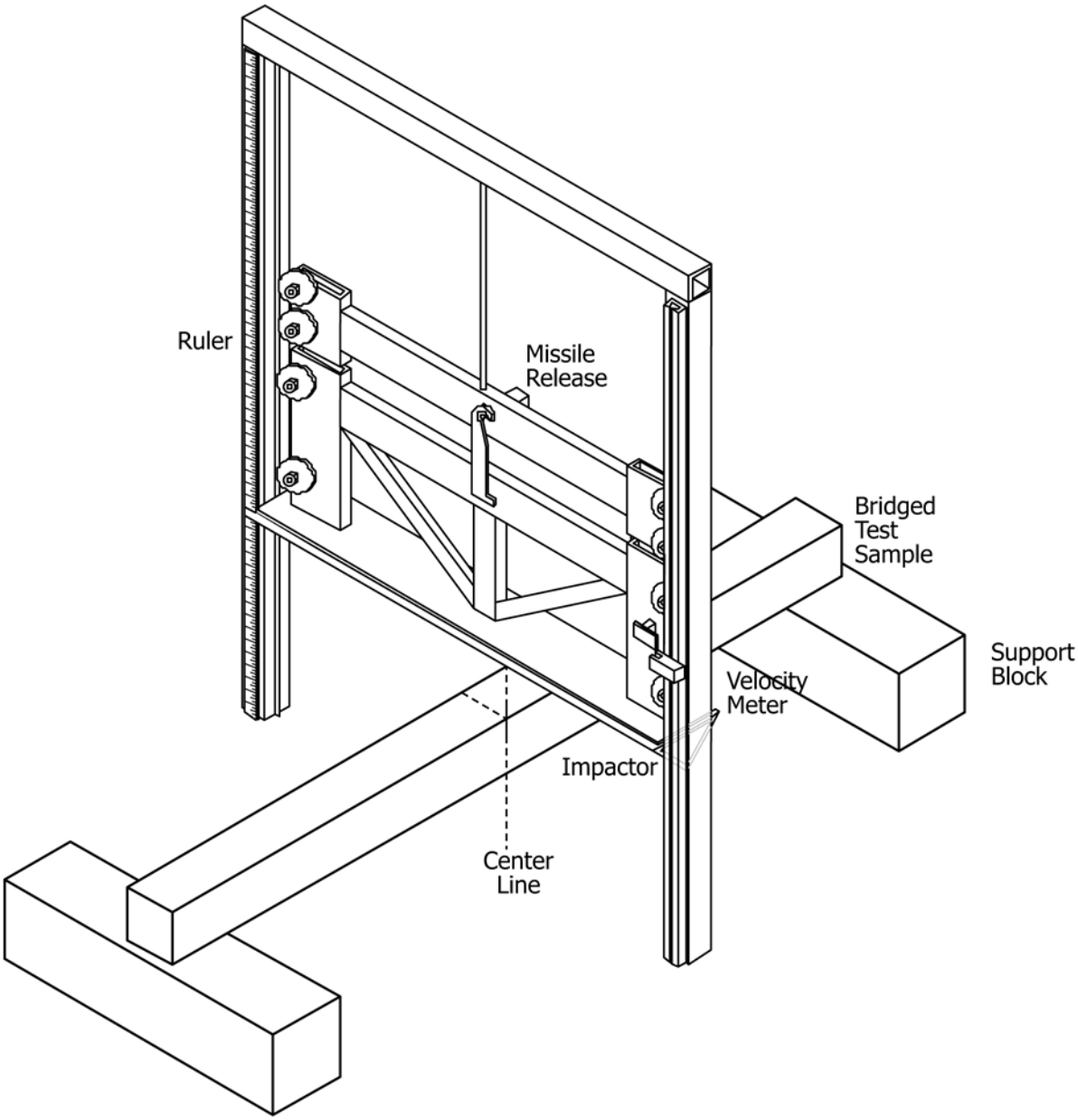

FIG. 2 Simulated Mechanical Impact Testing Equipment (S.M.I.T.E.)

physical test, water immersion, exposure to water spray, or exposure to standard or other fixed conditions of air temperature or humidity.

8.2 Unless otherwise specified, fiberboard packages shall be conditioned in accordance with Method D685 or Practice D4332. Other packages shall be conditioned in accordance with Practice D4332.

8.3 The moisture content of paperboard and fiberboard packages should be determined in accordance with Test Method D644.

9. Acceptance Criteria

9.1 Acceptance criteria must be established prior to testing and should consider the required condition of the product upon receipt. The organizations conducting the test may choose any acceptance criteria suitable for their purpose. It is advisable to compare the type and quantity of damage that occurred to the test specimens with the damage that occurs during actual distribution and handling, or with the test results of similar containers whose shipping history is known.

9.2 In many cases, the acceptance criteria can be one of the following:

(1) Criterion 1—Package is intact and product is damage free; or

(2) Criterion 2—Product is damage free and package abused.

This often means that the shipping container and its contents are suitable for normal sale and use at completion of the test cycle. Detailed acceptance criteria may allow for accepting specified damage to a product or package. The form and

content of acceptance criteria may vary widely, according to the particular situation. Methods may range from simple pass-fail judgments to highly quantitative scoring or analysis systems.

10. Procedure

10.1 *Determination of Acceptance Criteria*—Relate acceptance criteria to the desired condition of the product and package at the end of the distribution cycle (see Section 9).

10.2 *Option A: Free-Fall Drop Tester*—Place the package to be tested on the floor of the drop test apparatus, with it resting on support blocks. The support blocks should be placed parallel to each other and perpendicular to the long axis of the package, so that each end of the package is supported for 5 in. (127 mm) of its length, measured from each end (see Fig. 3).

10.2.1 Position the impactor on the drop table or sling it suitably so that the following conditions are met:

(1) The impactor's length will be at right angles to the test package length upon contact;

(2) The edge of the impactor shall strike the center of the package so that the plane containing this edge and the center of gravity of the impactor makes no more than a 5° angle with the vertical;

(3) The bottom edge of the impactor is the required drop height above the upper surface of the package being tested; and

(4) The midpoint of the bottom edge of the impactor strikes the midpoint of the impacted face of the package being tested.

10.2.2 Drop the impactor from a free-fall drop height sufficient to produce a specified impact velocity. Use an impact velocity of 111 in./s (2.8 m/s).

10.2.3 Obtain the impact velocity of 111 in./s (2.8 m/s) from a free-fall drop height of 16 in. (406 mm). Due to energy conservation, the potential energy before drop is equal to the kinetic energy at impact. The kinetic energy at impact will be 12 ft-lb (16.3 J). Equate an impact velocity to a free-fall drop height, or vice versa, as follows:

$$h = V_i^2/2\,g \ \text{(solving for free − fall drop height)} \qquad (1)$$

$$V_i = \sqrt{2\,gh}\ \text{(solving for impact velocity)}$$

where:

h = free-fall drop height, m (in.),
V_i = measured impact velocity, m/s (in./s), and
g = acceleration due to gravity, 9.8 m/s (386 in./s).

10.3 *Option B: Simulated Mechanical Impact Testing Equipment (S.M.I.T.E.)*—Place the package to be tested on the table of the S.M.I.T.E. test apparatus, with it resting on support blocks. The support blocks should be placed parallel to each other and perpendicular to the long axis of the package, so that each end of the package is supported for 5 in. (127 mm) of its length, measured from each end (see Fig. 3).

10.3.1 Position the impactor on the S.M.I.T.E. tester so that the following conditions are met:

(1) The impactor will strike the package with a long edge, at right angles to the length of the package being tested;

(2) The impactor shall strike the center of the package so that the plane containing this surface and the center of gravity of the impactor makes no more than a 5° angle with the vertical;

(3) The bottom edge of the impactor is the required drop height above the upper surface of the package being tested; and

(4) The midpoint of the bottom edge of the impactor strikes the midpoint of the impacted face of the package being tested.

10.3.2 Drop the impactor from a machine drop height sufficient to generate a specific impact velocity. If no impact velocity is specified, use an impact velocity of 48 in./s (1.2 m/s). Pre-test drops must be conducted until the test machine indicates the desired impact velocity.

NOTE 3—Different machines will have different frictions in their guide mechanisms. Impact velocity is therefore measured with the velocity sensor. Determine the required impact velocity based on the following relationship:

$$v = \sqrt{2\,gh} \qquad (2)$$

10.3.3 This impact velocity of 48 in./s (1.2 m/s) would theoretically be obtained from a free-fall drop height of 3 in. (76 mm); however, due to guide mechanism friction, test machines will require higher machine drop heights sufficient to produce the desired impact velocity. The kinetic energy at impact will be 12 ft-lb (16.3 J).

11. Report

11.1 Report the following information:

11.1.1 Specification of the test method option used: either Option A, free-fall drop; or Option B, simulated mechanical impact test equipment (S.M.I.T.E.).

11.1.2 Dimension of the package under testing; complete structural specifications; kinds of materials; description and

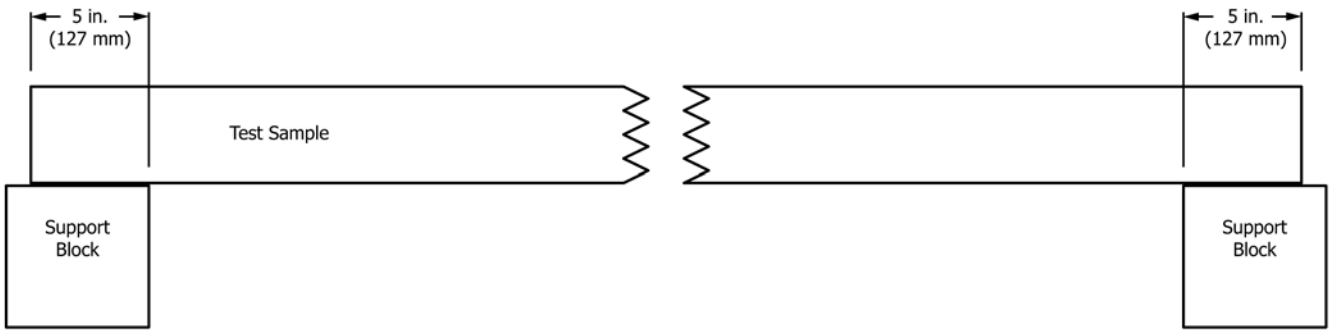

FIG. 3 Test Specimen Set Up

specifications for blocking and cushioning, if used; spacing, size, and type of fasteners; method of closing and strapping, if any; and tare and gross masses.

11.1.3 Description of the contents of the container under testing and, if not tested with the actual contents intended to be shipped, description of these actual contents.

11.1.4 Method of conditioning the container, if any; moisture content of the wood, plywood, or fiberboard, if determined; and results of any supplementary tests of the materials from which the container is made.

11.1.5 Mass of the impactor.

11.1.6 Drop height.

11.1.7 Kinetic energy (KE_i) at impact (see 10.2.3 and 10.3.3).

11.1.8 Number of specimens tested per sample.

11.1.9 Detailed record of testing on each package, including damage to the package and contents, together with any other observation that may assist in interpreting the results correctly or aid in improving the design of the package or the method of packing, blocking, or bracing.

11.1.10 Statement to the effect that all tests were conducted in full compliance with the requirements of this practice, or noting any variations and their details.

11.1.11 Name and address of the testing agency, date, and signature of a responsible representative of the testing agency.

12. Precision and Bias

12.1 No statement is made concerning either the precision or the bias of this test method. The result merely reveals whether there is performance to the criteria for success specified in the procedure.

13. Keywords

13.1 bridge impact; drop test; free-fall; packaging; S.M.I.T.E. tester