This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

Designation: D5414 – 95 (Reapproved 2020)

# Standard Test Method for Evaluation of Horizontal Impact Performance of Load Unitizing Stretch Wrap Films[1]

This standard is issued under the fixed designation D5414; 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 used to evaluate and compare the ability of stretch-wrap films to survive horizontal impacts in a laboratory simulation.

1.2 The test levels may be varied to represent the mode of shipping and handling used for the unit load under test.

1.3 The methodology of performing the controlled horizontal impacts is described in detail in Test Methods D4003. This test method will describe only sample preparation and evaluation in the special case of evaluating the performance of film for load unitizing.

1.4 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

2.1 *ASTM Standards:*[2]

D996 Terminology of Packaging and Distribution Environments

D4003 Test Methods for Programmable Horizontal Impact Test for Shipping Containers and Systems

D4169 Practice for Performance Testing of Shipping Containers and Systems

## 3. Terminology

3.1 *Definitions*—General definitions for packaging and distribution environments are found in Terminology D996.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *backload, n*—a duplicate specimen similar to the test package or weights to simulate the other lading in the transport vehicle.

3.2.2 *shock pulse programmer, n*—a device used to control the parameters of the acceleration versus time-shock pulse generated by a shock test impact machine.

## 4. Summary of Test Method

4.1 The horizontal impacts used in this test method are programmed shock inputs that represent the hazards as they occur in the shipping and handling environment. The environmental hazards may include rail switching impacts, pallet marshalling impacts, etc.

## 5. Significance and Use

5.1 This test method is intended to be used mainly as a means of comparing the performance of unitizing films. It can also be used to compare the effectiveness of different wrap cycles with the same wrapping materials. No direct correlation between these tests results and actual field performance has been established.

5.2 This test method simulates the horizontal impact elements of the distribution environment. Horizontal impacts are encountered in rail car switching and pallet marshalling procedures, both in the warehouse and during the loading and unloading of transport vehicles.

5.3 This test method leaves open to the discretion of the user the establishment of test levels and the number of impacts constituting the test so that one might tailor the test to simulate one's particular distribution environment. The section entitled "Element H—Simulated Rail Switching" in Practice D4169 may provide some guidance in this regard.

## 6. Apparatus

6.1 *Load Wrapping Apparatus*—A machine or apparatus to wrap the test load. The method of wrap application is preferably as near as possible to that used in an actual production situation (stretch wrapper or manual wrapping unit).

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[1] This test method is under the jurisdiction of ASTM Committee D10 on Packaging and is the direct responsibility of Subcommittee D10.25 on Palletizing and Unitizing of Loads.

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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.

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6.2 *Horizontal Impact Test Machine*—Refer to Test Methods D4003, paragraph 5.1 and following subparagraphs, for a complete description.

6.3 *Instrumentation*—Refer to Test Methods D4003, paragraph 5.3 and following subparagraphs, for a complete description.

## 7. Procedure

7.1 *Procedure A—Normal Test Mode:*

7.1.1 Prepare the test load. Arrange the units comprising the test load in layers and stack them on the pallet or slip sheet in the normal manner.

7.1.2 Wrap the test load with the unitizing film at a predetermined percent stretch and wrap cycle.

7.1.3 Allow the wrapped load to stand undisturbed for a minimum of 16 h before testing. This gives the stress retention forces in the stretched wrapping material time to equilibrate.

7.1.4 Perform the horizontal impact test. Follow the procedures detailed in Test Methods D4003 (Procedure A or B, depending on the specific hazard being simulated). For the purposes of this test method, the use of back loading can be eliminated since this would not normally affect the performance of the unitizing materials.

7.1.5 *Evaluation*—After completion of the desired horizontal impact cycle, inspect the load and note the degree of load shifting between layers. Also note any failure in the unitizing material such as horizontal or vertical splits, tears, holes, or other test-induced defects.

7.2 *Procedure B—Severe Test Mode:*

7.2.1 Perform this test in the same manner as Test Method A, except hold the unit load or block away from the horizontal bulkhead of the test carriage by placing a solid block approximately the size of one of the individual containers comprising the unit load on the floor of the test carriage between the test specimen and the bulkhead. This test mode will induce additional severe stresses on the load unitizing materials since, on impact, the unrestrained upper section of the unit load will tend to continue to move forward while the lower section will be prevented from doing so by the block on the floor of the test carriage.

7.2.2 This represents a severe situation and may not be indicative of the actual shipping situation of the user. However, this severe test can be useful as a comparative tool if the normal test shows no effect or is unable to differentiate between two materials or wrap cycles.

## 8. Report

8.1 Include the following information in the test report:

8.2 *Test Unit*—Complete description of the test load evaluated:

8.2.1 Dimensions of each unit (outside dimensions).

8.2.2 Dimension of unitized test load (circumference and height).

8.2.3 Number of individual units per test load.

8.2.4 Weight of each unit and total test load.

8.2.5 Orientation of test load.

8.3 *Wrap Material:*

8.3.1 Supplier.

8.3.2 Film thickness.

8.3.3 Roll width.

8.4 *Wrap Cycle*—Complete description of the wrap cycle used in the wrapping test load. Examples of a wrap cycle description in stretch-wrap film are as follows:

8.4.1 Set percent stretch gear ration or dial settings.

8.4.2 Actual measured percent stretch.

8.4.3 Overlap up.

8.4.4 Top dwell, revolutions.

8.4.5 Overlap down.

8.4.6 Bottom dwell, revolutions.

8.4.7 Total table rotation.

8.4.8 Film used (weight or purposes footage, or both).

8.4.9 Date and time wrapped and date and time testing began.

8.5 *Test Parameters:*

8.5.1 Number of impacts the unit received.

8.5.2 Velocity change for each of the impacts.

8.5.3 Pulse duration of the impact shock.

8.5.4 Distance the load was blocked away from the bulkhead of the test carriage (if applicable).

8.6 *Stretch-Wrap Material Evaluation*—Detailed description of the type of damage resulting from the test and the condition of the unit load after completion of the impact testing. Some examples of damage modes are as follows:

8.6.1 Tearing of material on corners.

8.6.2 Splitting of the film on the sides of the test load, either horizontally or vertically.

8.6.3 Permanent load shifting, that is, a permanent shift of the layers of the unit load with respect to one another, resulting in a leaning or skewed load.

8.6.4 Loss of test load and integrity, that is, shifting of layers to the point of toppling over or losing individual units out of the test load.

8.6.5 Procedure used.

## 9. Precision and Bias

9.1 No statement is made concerning either the precision or bias of this test method since the results state merely whether this is in conformance with the criteria for success specified by the user of this test method.

## 10. Keywords

10.1 impact; stretch wrap materials; thin films

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