Designation: D5415 – 95 (Reapproved 2012)

Standard Test Method for Evaluating Load Containment Performance of Stretch Wrap Films by Vibration Testing[1]

This standard is issued under the fixed designation D5415; 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 contain unitized loads during shipping.

1.2 *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]

D996 Terminology of Packaging and Distribution Environments

D999 Test Methods for Vibration Testing of Shipping Containers

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 *amplitude*—the maximum value of a sinusoidal quantity (zero to peak).

3.2.2 *resonance*—a system of forced vibration existing when any change, however small, in the frequency of excitation causes a decrease in the response of the system.

4. Significance and Use

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

4.2 This test method simulates the shipping of unitized loads by way of truck and rail, concentrating on the vibration element associated with these modes. Other elements of the distribution system, such as mechanical handling, are not addressed specifically in this test method.

4.3 This test method establishes a method for rating the performance of films, but it leaves open to the discretion of the user the establishment of an acceptable rating for the specific end-use intended.

5. Apparatus

5.1 *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).

5.2 *Vibration Table*—A vibration testing apparatus conforming to Test Methods D999, preferably equipped with the capability of varying the frequency or amplitude, or both, of vibration input in a controlled fashion and maintaining a set vibration mode.

5.2.1 The table shall be large enough and have a weight capacity sufficient to hold an entire wrapped shipping unit.

5.2.2 The table should have a means for attaching the bottom of the wrapped test unit securely to the table (for example, threaded holes in the table surface for bolting a pallet securely to the table).

5.3 *Accelerometer* (optional), to measure the output response of the test load at various vibration table input frequencies. This is the most accurate way of determining the resonant frequency of the test load.

6. Procedure

6.1 Prepare the test load. Arrange the units comprising the test load in layers and stack them in the manner normally used for shipping the product.

6.2 When the units are normally shipped on pallets, stack the units on the pallet in the normal manner.

[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.

6.3 When the units are normally shipped on slip sheets without pallets, stack the units on slip sheets and affix the bottom layer to the slip sheet in the normal manner (glue, hot melt adhesive, and adhesion promoter). The slip sheet should have been fixed previously to a pallet surface to provide a means of securing the load to the vibration table.

6.4 Wrap the test load with the stretch-wrap film at a predetermined percent stretch and wrap cycle.

6.5 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.

6.6 Place the test load on the vibration table and secure it firmly in place.

6.7 Perform a frequency sweep, and determine the resonant frequency of the entire wrapped test load. An accelerometer placed on top of the load monitored with a chart recorder or a storage oscilloscope is the most precise method of determining the resonant frequency. Alternatively, visual inspection can generally be used to determine the resonant frequency with sufficient accuracy. Further details of this resonance search test can be found in Test Methods D999, Method C. Perform the remainder of the test at the determined resonant frequently.

6.8 Begin the test with the vibration table at the resonant frequency of the load and at 0.5 G (see Note) input amplitude (zero to peak). Vibrate the test load for 10 min, watching for load shifting, tearing, or splitting of the wrapping material, or other loss of load integrity. If the load survives, adjust the amplitude to 0.75 G while maintaining resonant frequency. Increase the input amplitude at 10-min intervals in 0.25-G increments up to a maximum of 1.25 G. A summary of the testing schedule is shown in Fig. 1.

NOTE 1—G = gravity (see Terminology D996).

6.9 Discontinue the testing if the film tears or the cube integrity is lost before the entire test is completed. Record the G level at which the film failed and the number of min it survived at that G level. The film and wrap cycle combination can be given a numerical rating by multiplying G levels by the number of minutes survived as shown in Fig. 1. If desired, a minimum acceptable rating can be established for qualifying film or wrap cycles for use with the load tested.

7. Report

7.1 Report the following information:

7.2 *Test Unit*—Complete description of the test load evaluated.

7.2.1 Dimensions of each unit (outside dimensions).

7.2.2 Dimensions of the unitized test load (circumference and height).

7.2.3 Number of individual units per test load.

7.2.4 Weight of each unit and total test load.

7.3 *Wrap Material:*

7.3.1 Supplier and material type.

7.3.2 Film thickness.

7.3.3 Roll width.

7.4 *Wrap Cycle*—Complete description of the wrap cycle used in the wrapping test load. Examples of wrap cycle and spiral wrap descriptions are as follows:

Input Amplitude, G	Duration, min	Rating, min × G	Cumulative Rating
0.50	10	5.0	5.0
0.75	10	7.5	12.5
1.00	10	10.0	22.5
1.25	10	12.5	35.0

Sample Report Format for Specific Type of Wrap Materials with Wrapping Equipment

STRETCH WRAP EVALUATION REPORT

Supplier and Film Type:
Film Thickness (mil):
Roll Width:
Gear Ratio or Percent Stretch:
Product Wrapped:
Date Wrapped:
Counter Settings:
Top Dwell _____ Roll Speed _____ up Overlap up _____ in.
Bottom Dwell _____ Roll Speed _____ down Overlap down _____ in.
Table Rotations:
Quarter turns _____ Full turns _____
Film Used: _____ ft. Weight: _____ g
Measured Percent Stretch:
Overall _____ Roller Stretch Actual _____ Retained _____ (after test)
( ) Film Survived
( ) Film Failed at _____ G _____ min
Film Rating (G × min) _____ Cube Resonance _____ HZ
Comments:

Cube No. _____
Cube Circumference _____ in.
Date Tested:

NOTE—G = gravity (see Terminology D 996).

FIG. 1 Summary of Testing Schedule

7.4.1 Setting of dial or gear ratio used for desired percent stretch.
7.4.2 Actual measured percent stretch.
7.4.3 Overlap up.
7.4.4 Top dwell, revolutions.
7.4.5 Overlap down.
7.4.6 Bottom dwell, revolutions.
7.4.7 Total table rotations.
7.4.8 Film used (weight or unstretched footage, or both).
7.4.9 Date and time wrapped and date and time testing began.

7.5 *Test Sequence:*
7.5.1 Resonance frequency of the test load.
7.5.2 Duration and G level of each portion of the test.

7.6 *Wrapping Material Performance Rating:*
7.6.1 Time and G level at failure or indication (survival, if the material survived the entire test).
7.6.2 Film rating (G multiplied by minutes duration), cumulative (see Fig. 1).
7.6.3 *Type of Failure*—Some examples of failure modes are as follows:
7.6.3.1 Tearing of material at the corners.
7.6.3.2 Splitting of film on the side of the test load.
7.6.3.3 Development of holes in film materials.
7.6.3.4 Loss of test load integrity, such as the shifting of top layers with respect to bottom layers to the point of toppling over or the migration of individual units out of the test load.
7.6.4 *Additional Comments*—Additional comments should be made in the report concerning any other attributes of the wrapped load noted during the wrapping and vibration sequence. Note observations such as rounding or other corner damage from the wrapping material, or any crushing or distortion of individual units.

7.7 A sample report format that could be used for a specific type of wrap material and wrapping equipment is shown inFig. 1.

8. Precision and Bias

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

9. Keywords

9.1 load containment; stretch wrap materials; thin films; vibration