Designation: D5416 − 95 (Reappproved 2020)

Standard Test Method for Evaluating Abrasion Resistance of Stretch Wrap Films by Vibration Testing[1]

This standard is issued under the fixed designation D5416; 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 compares the abrasion resistance of similar types of stretch wrap films.

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

1.3 *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

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 *overlap, n*—the width of stretch wrap material that covers a previous layer of stretch wrap material.

3.2.2 *stretch wrap material*—a material used for overwrapping, which when applied under tension, elongates and conforms to the item(s) packaged through elastic recovery.

3.2.3 *wrap cycle, n*—the series of operations used to wrap a load.

4. Significance and Use

4.1 This test method is intended to provide only a comparative procedure for evaluating unknown films against a standard or control film whose performance has been defined as adequate in actual field conditions.

4.2 This test method leaves open to the discretion of the user several key factors, including film wrap method, abrasion surfaces, and definition of failure, so that it can be tailored to an individual user's distribution parameters.

4.3 This test method is meant to simulate, in an accelerated mode, the abrasion that an outer wrapping of film might encounter in a typical shipping and distribution environment.

4.4 This is a test procedure that allows the user to make relative comparisons of the abrasion resistance of a film, such as that the film is containing a palletized load while that load is undergoing vibration.

5. Equipment and Preparation

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

5.2 *Vertical Vibration Table,* preferably equipped with the capability of varying the frequency or amplitude, or both, of vibration in a controlled fashion and maintaining a set vibration mode.

5.3 *Upright Supports*—Rigid upright supports that can be bolted or secured otherwise to the vibration table. These supports shall also be adjusted laterally so as to confine the test load and prevent excessive side to side movement or toppling.

5.4 *Abrasive Surfaces,* attached to the inner faces of upright supports so that the wrapped test load comes into contact with and abrades against this surface during the test sequence.

5.4.1 The abrasive surface can be composed of any one of a variety of possible substances, chosen at the user's discretion, to simulate the actual abrasive surfaces that might be encountered in the actual distribution cycle. Possibilities include

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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.

rough side of exterior-grade plywood, wooden slats, corrugated metal, corrugated paperboard, brick facings, and standard grit sandpaper.

5.5 *Timing Device*—Stopwatch, clock, or timer.

5.6 *Accelerometer* (optional), which may be used to measure the output response of the test load at various vibration table input amplitudes. This is the most accurate way of determining the resonant frequency of the test load.

6. Procedure

6.1 Prepare two single columns of units to be wrapped.

6.2 Wrap each single column of units individually using the method to be used under normal conditions.

6.3 If other stretch levels are not defined in the production situation, the standard levels of stretch film application of 50, 100, or 150 % stretch may be used.

6.4 If it is desired to simulate a two-column-high stacking mode, a piece of corrugated or solid fiber slip sheet material or plastic sheet can be placed on top of the first columns, and a second column can be stacked on top of the first.

6.5 Set the wrapped test column(s) on the vibration table and confine on all sides with an upright support such that the rough surface face is facing the test columns. Set the supports sufficiently close in to prevent toppling of the columns but not close enough to restrict the free movement response to vibration.

6.6 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. As an alternative, 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 resonant vibration frequency.

6.7 Vibrate the wrapped test column on the vibration apparatus for a predetermined total time (for example, 60 min). At selected intervals during the test (for example, 10 or 15 min), stop the apparatus and inspect the wrap on the load on all sides for signs of abrasion, holes, or tears, and record the observation. Inspect and measure the abrasion at the top, center, and bottom of the column, and record the position of any visible abrasion. Continue the test for the predetermined total test times or until the film reaches failure.

6.8 Record the amount of damage at the end of the test period or time to failure.

7. Report

7.1 Report the following information:

7.2 *Test Unit:*

7.2.1 Dimensions of each unit (outside diameter).

7.2.2 Weight of each unit.

7.2.3 Number of units per column on the wrapped load.

7.3 *Test Film*—Complete description (caliper, grade, and roll width).

7.4 *Wrap Cycle*—Examples including the following:

7.4.1 Stretch film (spiral).

7.4.2 Percent stretch.

7.4.3 Stretch wrapper settings.

7.4.4 Revolutions at bottom.

7.4.5 Overlap up and down.

7.4.6 Revolutions at top.

7.5 *Abrasion Surface on Upright Supports*—Complete description (see 5.4.1).

7.6 *Test Sequence:*

7.6.1 Resonance frequency or machine setting at which the test is run.

7.6.2 Total test duration.

7.6.3 Inspection interval.

7.7 *Performance Rating*—Time to failure or description of the extent of abrasion after the total test cycle. Examples of possible failure modes include the following:

7.7.1 Holes in one or more outer layers of the film wrap but not completely through all layers.

7.7.2 Hole worn completely through all layers of the film wrap.

7.7.3 Tearing of the film at the corners of the load.

7.7.4 Splitting of film (note the extent of the split propagation).

8. Precision and Bias

8.1 No statement is made concerning 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.

9. Keywords

9.1 abrasion resistance; stretch wrap; thin films