ASTM D4169 Performance Testing of Shipping Containers and Systems- Testing Equipment

Description

1 Scope*
1.1 This practice provides a uniform basis of evaluating, in a laboratory, the ability of shipping units to withstand the distribution environment. This is accomplished by subjecting them to a test plan consisting of a sequence of anticipated hazard elements encountered in various distribution cycles. This practice is not intended to supplant material specifications or existing preshipment test procedures.
1.2 Consider the use of Practice D7386 for testing of packages for single parcel shipments.
1.3 The suitability of this practice for use with hazardous materials has not been determined.
1.4 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.
1.5 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.

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TABLE 1 Distribution Cycles

DC	Distribution Cycle	Performance Test Schedule Sequence (see Section 9 for Test Schedule definition) First	Second	Third	Fourth	Fifth	Sixth	Seventh
1	General Cycle—undefined distribution system	Schedule A Handling	Schedule D Stacked Vibration	Schedule F Loose-Load Vibration	Schedule G Rail Switching	Schedule J Concentrated Impact	Schedule A Handling	
2	Specially defined distribution system, user specified (see Appendix X2)	select from Schedules A through I						
3	Single package without pallet or skid, LTL motor freight	Schedule A Handling —Manual	Schedule D Stacked Vibration OR Schedule C Vehicle Stacking plus Schedule E Vehicle Vibration	Schedule F Loose-Load Vibration	Schedule J Concentrated Impact	Schedule A Handling—Manual	. . .	
4	Single package with pallet or skid, LTL motor freight	Schedule A Handling —Mechanical	Schedule D Stacked Vibration OR Schedule C Vehicle Stacking plus Schedule E Vehicle Vibration	Schedule F Loose-Load Vibration	Schedule J Concentrated Impact	Schedule A Handling—Mechanical	. . .	
5	Motor freight, TL, not unitized	Schedule A Handling	Schedule D Stacked Vibration	Schedule E Vehicle Vibration	Schedule J Concentrated Impact	Schedule A Handling	. . .	
6	Motor freight, TL, or LTL—unitized	Schedule A Handling	Schedule D Stacked Vibration OR Schedule C Vehicle Stacking plus Schedule E Vehicle Vibration	Schedule J Concentrated Impact	Schedule A Handling	Schedule B Warehouse Stacking	. . .	
7	Rail only, bulk loaded	Schedule A Handling	Schedule D Stacked Vibration	Schedule G Rail Switching	Schedule A Handling	. . .	. . .	
8	Rail only, unitized	Schedule A Handling	Schedule D Stacked Vibration	Schedule G Rail Switching	Schedule A Handling	Schedule B Warehouse Stacking	. . .	
9	Rail and motor freight, not unitized	Schedule A Handling	Schedule C Vehicle Stacking	Schedule E Vehicle Vibration	Schedule G Rail Switching	Schedule F Loose-Load Vibration	Schedule J Concentrated Impact	Schedule A Handling
10	Rail and motor freight, unitized	Schedule A Handling	Schedule D Stacked Vibration	Schedule G Rail Switching	Schedule J Concentrated Impact	Schedule A Handling	Schedule B Warehouse Stacking	
11	Rail, TOFC and COFC	Schedule A Handling	Schedule G Rail Switching	Schedule D Stacked Vibration	Schedule F Loose-Load Vibration	Schedule A Handling	. . .	
12	Air (intercity) and motor freight (local), over 150 lb (68.1 kg), or unitized	Schedule A Handling	Schedule D Stacked Vibration	Schedule I Low Pressure[A]	Schedule E Vehicle Vibration	Schedule J Concentrated Impact	Schedule A Handling	
13	Air (intercity) and motor freight (local, single package up to 150 lb (61.8 kg). Consider using Practice D7386 for single parcel carrier shipments.	Schedule A Handling	Schedule C Vehicle Stacking	Schedule F Loose-Load Vibration	Schedule I Low Pressure[A]	Schedule E Vehicle Vibration	Schedule J Concentrated Impact	Schedule A Handling
14	Warehousing (partial cycle to be added to other cycles as needed)	Schedule A Handling	Schedule B Warehouse Stacking	. . .	. . .	. . .	. . .	
15	Export/Import shipment for intermodal container or roll on/roll off trailer (partial cycle to be added to other cycles as needed)	Schedule A Handling	Schedule C Vehicle Stacking	Schedule A Handling	. . .	. . .	. . .	

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Direct Sales by Manufacturer

TABLE 1 *Continued*

DC	Distribution Cycle	Performance Test Schedule Sequence (see Section 9 for Test Schedule definition) First	Second	Third	Fourth	Fifth	Sixth	Seventh
16	Export/Import shipment for palletized cargo ship (partial cycle to be added to other cycles as needed)	Schedule A Handling	Schedule C Vehicle Stacking	Schedule A Handling	. . .	. . .	. . .	
17	Export/Import shipment for break bulk cargo ship (partial cycle to be added to other cycles as needed)	Schedule A Handling	Schedule C Vehicle Stacking	Schedule A Handling	. . .	. . .	. . .	
18	Non-Commercial Government shipments per MIL-STD-2073-1	Refer to Annex A1 for Test Schedules applying to DC-18.						

[A] This high altitude, non-pressurized transport simulation test may be deleted from this distribution cycle when testing shipping units that contain primary packages that have a porous material.

7 Acceptance Criteria

7.1 Acceptance criteria must be established prior to testing and should consider the required condition of the product at 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 test results of similar containers whose shipping history is known.

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7.2 In many cases, the acceptance criteria can be the following:
Criterion 1â€”Product is damage-free.
Criterion 2â€”Package is intact.
Criterion 3â€”Both criteria 1 and 2.
Often, this means that the shipping container and its contents are suitable for normal sale and use at the completion of the test cycle. Detailed acceptance criteria may allow for accepting specified damage to a product or its package. The form andcontent of acceptance criteria may vary widely, in accordance with the particular situation. Methods may range from simple pass-fail judgments to highly quantitative scoring or analysis systems.

8 Procedure

8.1 Define Shipping Unitâ€”Describe shipping unit in terms of size, weight, and form of construction. See 3.2.7. Determine whether the container will be manually or mechanically handled.
8.2 Establish Assurance Levelâ€”Specify a level of test intensity. The level should be one of three pre-established assurance levels. This must be pre-established based on the product value, the desired level of anticipated damage that can be tolerated, the number of units to be shipped, knowledge of the shipping environment, or other criteria. Assurance Level II is suggested unless conditions dictate otherwise. Assurance Level I provides a more severe test than II. Assurance Level III provides a less severe test than II. The assurance level may be varied between schedules (see Sections 10 â€“ 15) if such variations are known to occur. The test levels used should be reported. See Section 18.
8.3 Determine Acceptance Criteriaâ€”Acceptance criteria are related to the desired condition of the product and package at the end of the distribution cycle. See Section 7.
8.4 Select Distribution Cycleâ€”Select a Distribution Cycle from the available standard distribution cycles compiled in Table 1. Use the DC that most closely correlates with the projected distribution. When the distribution is undefined, the general distribution cycle DC-1 should be selected. When the anticipated distribution is well understood, a special distribution cycle DC-2 may be specified. In using DC-2, the user
selects test schedules from Section 9 and specifies the test sequence (see Appendix X2 for more

details). For purposes of DC-3 and DC-13, the bottom of a single package is the surface on which the package rests in its most stable orientation. The identified bottom should be utilized for purposes of determining the starting orientation of each test schedule within the above stated distribution cycles.
8.5 Write Test Planâ€”Prepare a test plan by using the sequence presented in Table 1 for the distribution cycle selected. Obtain the test intensities from the referenced schedules. The test plan intensity details must take into account the assurance levels selected as well as the physical description of the shipping unit. Table 1 thus leads to a detailed test plan consisting of the exact sequence in which the shipping unit will be subjected to the test inputs. The test schedules associated with each element reference the existing ASTM test methods for clarification of the equipment and techniques to be used to conduct the test.

8.5.1 Sample test plans are provided in Appendix X1.
8.6 Select Samples for Testâ€”See Section 5.
8.7 Condition Samplesâ€”See Section 6.
8.8 Perform Testsâ€”Perform tests as directed in reference ASTM standards and as further modified in the special instructions for each test schedule.
8.9 Evaluate Resultsâ€”Evaluate results to determine if the shipping units meet the acceptance criteria. See Section 7.
8.10 Document Test Resultsâ€”Document test results by reporting each step. See Section 18.
8.11 Monitor Shipmentsâ€”When possible, obtain feedback by monitoring shipments of the container that was tested to ensure that the type and quantity of damage obtained by the laboratory testing correlates with the damage that occurs in the distribution cycle. This information is very useful for the planning of subsequent tests of similar shipping containers.

9 Hazard Elements and Test Schedules
9.1 Hazard Elements and Test Schedules are categorized as follows:

Schedule	Hazard Element	Test	Section
A	Handling—manual and mechanical	drop, impact, stability	10
B	Warehouse Stacking	compression	11
C	Vehicle Stacking	compression	11
D	Stacked Vibration	vibration	12
E	Vehicle Vibration	vibration	12
F	Loose Load Vibration	repetitive shock	13
G	Rail Switching	longitudinal shock	14
H	Environmental Hazard	cyclic exposure	15
I	Low Pressure Hazard	vacuum	16
J	Concentrated Impact	impact	17

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Impact Test According to ISO 21809-3

ISO 6603-1 Determination of Puncture Impact Behaviour of Rigid Plastics Non-Instrumented Impact Testing / Testing Equipment

Vibration Tester

ASTM D4169 â€“ Standard Practice for Performance Testing of Shipping Containers and Systems â€“ Compression Tests â€“ Testing Equipment

Single Column Tensile Compression Tester (UTM)-100 Kg-500mm

- Universal Tensile Compression Tester (UTM)
- Falling Weight Impact Tester
- Pendulum Impact Tester (Izod, Charpy, Tensile impact)

Notch Milling Machine for Pendulum Tester-IZOD

Laboratory Injection Molding Machine-155mm

Melt Flow Index Tester (MFI, MFR)

- Precise Balance and Density Kit
- Pallet and Box Compression Tester-100KN-150x150x60

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Category

1. Equipment for Standards
2. Standards