Designation: ~~D7387 – 07~~ D7387 – 13

Standard Test Method for Vibration Testing of Intermediate Bulk Containers (IBCs) Used for Shipping Liquid Hazardous Materials (Dangerous Goods)[1]

This standard is issued under the fixed designation D7387; 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 covers vibration testing of filled intermediate bulk containers (IBCs) intended to contain liquid hazardous materials (dangerous goods) and is suitable for testing IBCs of any design or material with any means of closure. This test method has been used by the United States Department of Transportation (DOT) to test and qualify IBCs for shipping hazardous materials. The test method is used to determine that the IBCs maintain integrity and to prevent leakage or spillage of contents during shipping. This test method should be used as a screening tool or as a design qualification test. Other vibration methods are available to more closely simulate vibration experienced in transportation.

1.2 This test method is appropriate for testing IBCs ranging from 450 to 3000 L (119 to 793 gal). Packagings of smaller sizes should be tested using Test Methods D999 or other applicable methods.

1.3 The ISO 2247 standard may not meet the requirements for this test method.

1.4 The values stated in SI units are to be regarded as standard. The values given in parentheses are for information only.

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*. Specific precautionary statements are given in Section 6.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D996 Terminology of Packaging and Distribution Environments

D999 Test Methods for Vibration Testing of Shipping Containers

D4169 Practice for Performance Testing of Shipping Containers and Systems

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~~

2.2 *ISO Standards:*[3]

ISO 2247 Packaging—Complete, Filled Transport Packages—Vibration Test at Fixed Low Frequency

2.3 *Regulatory Documents:*[4]

CFR 49 United States Department of Transportation Code of Federal Regulations Title 49, Transportation, Parts 100–199

2.4 *United Nations Document:*[5]

United Nations Recommendations on the Transport of Dangerous Goods—Model Regulations

[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.

Current edition approved ~~Oct. 15, 2007~~Feb. 1, 2013. Published ~~November 2007~~April 2013. Originally approved in 2007. Last previous edition approved in 2007 as D7387–07. DOI: ~~10.1520/D7387-07.~~10.1520/D7387-13.

[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] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[4] Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, http://www.access.gpo.gov.

[5] Available from United Nations, 866 United Nations Plaza, New York, NY 10017.

3. Terminology

3.1 For definitions of terms used in these test methods, see Terminology D996.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *double amplitude, n*—the maximum value of a sinusoidal quantity (peak-to-peak).

3.2.2 *repetitive shock, n*—impacts of a package on a test platform which occur cyclically from input oscillatory motion.

3.2.3 *resonance, n*—~~for the purposes of this test method, resonance is obtained when the input~~ a condition during a vibration test, when the forcing (input) frequency of the table ~~causes excessive, violent, and uncontrollable movement of the IBC. Testing at this frequency over an extended period of time is overly severe and may cause damage and failure to the container not likely to be experienced in transportation.~~equals the resonant frequency of the IBC and will produce the highest transmissibility level.

NOTE 1—Testing close to or at the resonant frequency of the IBC may cause excessive, violent, and uncontrollable movement of the IBC. For this method, testing at or near the resonant frequency is overly severe and may cause damage or failure to the container not likely to be experienced in transportation.

4. Significance and Use

4.1 Shipping containers are exposed to complex dynamic stresses when subjected to vibration present in transportation vehicles. Approximating the actual damage, or lack of damage, experienced in shipping may require subjecting the container(s) and contents to vibration inputs.

4.2 Resonant responses during shipment can be severe and may lead to failure of the container and spillage or leakage of contents. Identification of critical frequencies and the nature of package stresses can aid in minimizing the effect of these occurrences.

4.3 This vibration test is based on methods currently used for the qualification of IBCs in CFR 49 and has demonstrated successful use in transportation.

4.4 Exposure to vibration can affect the shipping container, its means of closure, and its contents. This test method allows analysis of the interaction of these components. Design modification to one or more of these components may be utilized to achieve optimum performance in the shipping environment.

4.5 This test method is suitable for individual filled containers that are transported unrestrained on the bed of a vehicle.

4.6 This test method is not intended for testing intermediate bulk containers at a frequency that causes the container to go into resonance.

5. Apparatus

5.1 *Vertical Motion Vibration Machine*—This test is to be conducted with vibration test equipment that provides vertical vibration, and is capable of producing frequencies in the range of 2 to at least 5 Hz, with a fixed double amplitude displacement of 25 mm (1 in.) ± 1 mm. The test machine shall have a platform with a known mass and with a horizontal surface of sufficient strength and rigidity so that all points of the surface will follow the vertical motion of the supporting structure when loaded with the IBC. The test surface shall protrude beyond the IBC on all sides and shall have hardness adequate for its intended use (recommend at least equal to oak wood) firmly attached to a mild steel structure. The platform shall be supported by a mechanism that moves the platform so the motion is a vertical sinusoidal input. (A rotary motion of the platform is not acceptable.) The vibration test machine shall be equipped with fences, barricades, or other restraints to keep the IBC from falling off the platform without restricting its vertical motion.

5.1.1 *Shim*—A metal shim with the following specification is used in determining when the shipping container is leaving the testing platform by a sufficient amount:

5.1.1.1 *Width*—50 mm (2.0 in.) minimum.

5.1.1.2 *Thickness*—1.6 mm (1⁄16 in.).

5.1.1.3 *Length*—254 mm (10 in.) minimum.

5.2 Fig. 1 shows an intermediate bulk container on a test apparatus.

5.3 *Instrumentation*—Instrumentation of the test unit and table as described below is not required but may be used to obtain additional data.

5.3.1 Accelerometers, signal conditioners, and data display or storage devices may be used to measure and control the accelerations at the test surface or on various locations of the intermediate bulk container to measure response. They are not required to conduct the test.

5.3.2 If an instrumentation system is used, it is recommended that it shall have a response accurate to within ±5 % over the range specified for the test.