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Standard Guide for Preparation of Plastic Packagings Containing Liquids for United Nations (UN) Drop Testing¹

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1. Scope*

1.1 This guide is intended to provide a standardized method and a set of basic instructions for special preparation conditioning of drop test samples being subjected to United Nations (UN) performance-oriented packaging certification as required by United States Department of Transportation Title 49 Code of Federal Regulations (49 CFR) and the United Nations Recommendations on the Transport of Dangerous Goods (UN).

1.2 This guide provides guidance on conditioning test samples for drop testing plastic Non-Bulk Packaging, Intermediate Bulk Container (IBC), and Large Packaging designs intended for liquid hazardous materials (dangerous goods) as required by 49 CFR §178.603(c)(1), §178.810(b)(4), and §178.965(c), respectively. This guide also provides the minimum information that should be documented when conducting special preparation conditioning.

1.3 The user of this guide shall be trained in accordance with 49 CFR §172.700 and other applicable hazardous materials regulations including: the International Civil Aviation Organization (ICAO) Technical Instructions for the Safe Transport of Dangerous Goods by Air, the International Maritime Dangerous Goods Code (IMDG Code), and carrier rules such as the International Air Transport Association (IATA) Dangerous Goods Regulations.

1.4 *Units*—The values stated in SI units are regarded as the standard. No other units of measurement are included in this 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *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

[D4332 Practice for Conditioning Containers, Packages, or Packaging Components for Testing](#)

[D4919 Guide for Testing of Hazardous Materials \(Dangerous Goods\) Packagings](#)

[D7887 Guide for Selection of Substitute, Non-hazardous, Liquid Filling Substances for Packagings Subjected to the United Nations Performance Tests](#)

[D8135 Guide for Selection of Substitute, Non-hazardous, Particulate Solid Filling Substances for Packagings Subjected to the United Nations Performance Tests](#)

2.2 Federal Standard:

[U.S. Department of Transportation Code of Federal Regulations Title 49 \(49 CFR\) Parts 100-185³](#)

2.3 UN Standard:

[United Nations Recommendations on the Transport of Dangerous Goods, Model Regulations \(UN Orange Book\)⁴](#)

2.4 IATA Standard:

[International Air Transport Association \(IATA\) Dangerous Goods Regulations⁵](#)

2.5 ICAO Standard:

[International Civil Aviation Organization \(ICAO\) Technical Instructions for the Safe Transport of Dangerous Goods by Air⁶](#)

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 Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402-9371 (www.phmsa.dot.gov/phmsa-regulations).

⁴ Available from the UN Economic Commission for Europe, Information Service, Palais des Nations, CH-1211 Geneva 10 Switzerland (website: <http://www.unece.org/trans/danger/danger.htm>).

⁵ Available from the International Air Transport Association (IATA), 800 Place Victoria, PO Box 113, Montreal, Quebec H4Z 1M1 Canada (website: <http://www.iata.org>).

⁶ Available from the International Civil Aviation Organization, (ICAO), 999 University St., Montreal, Quebec H3C 5H7 Canada (website: <http://www.icao.org>).

¹ This guide is under the jurisdiction of ASTM Committee D10 on Packaging and is the direct responsibility of Subcommittee D10.22 on Hazardous Materials.

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*A Summary of Changes section appears at the end of this standard

2.6 IMDG Standard:

International Maritime Dangerous Goods (IMDG) Code ⁷

3. Terminology

3.1 Definitions:

3.1.1 *ambient, adv*—the temperature and humidity of the surrounding environment where sample preparation is conducted.

3.1.2 *conditioning period, n*—minimum time required for test sample(s) and contents to reach the appropriate temperature.

3.1.3 *environmental conditioning chamber(s), n*—compartment, cabinet, or enclosed room that has the ability to achieve low temperatures and maintain those temperatures (or below) during the conditioning period. Examples are *chest, upright freezer, or walk-in freezer*.

3.1.4 *mapping, v*—collecting temperature data at multiple interior or exterior locations of a package or inside the chamber to determine the temperature variability range.

3.1.4.1 *Discussion—Units*—All temperature readings are in degrees Celsius.

3.1.5 *specific gravity, n*—ratio of the testing substance density to a standard substance (i.e., water) density at a specific temperature and pressure.

3.1.5.1 *Discussion*—For solids and liquids, the standard substance is normally water at 4.0°C with a 1.00 kg/L density.

3.1.6 *thermocouple, n*—device for measuring temperature. It consists of two dissimilar metals, joined together at one end. When the junction of the two metals is heated or cooled a voltage is produced that can be correlated back to the temperature. The thermocouple alloys are commonly available as wire.

3.1.7 *water/antifreeze solution, n*—liquid solution with a 0.95 minimum specific gravity at –18°C and does not freeze above –24°C.

3.2 Applicable Packaging Definitions Related to Dangerous Goods Regulations:

3.2.1 *combination package, n*—combination of packagings for transport purposes consisting of one or more inner packagings secured in a non-bulk outer packaging. It does not include a composite packaging.

3.2.2 *composite packaging, n*—packaging consisting of an outer packaging and an inner receptacle so constructed that the inner receptacle and the outer packaging form an integral packaging. Once assembled, it remains thereafter an integrated single unit and it is filled, stored, transported, and emptied as such.

3.2.3 *inner packaging, n*—packaging for which an outer packaging is required for transport. It does not include the inner receptacle of a composite packaging.

3.2.4 *package, n*—the completed product; the packaging plus its contents prepared for transport.

3.2.5 *packaging(s), n*—the receptacle(s) (without contents) and any other components or materials necessary for the receptacle(s) to perform their containment function.

3.2.6 *receptacle, n*—containment vessel for receiving and holding substances or articles, including any means of closing.

3.2.7 *single packaging, n*—non-bulk packaging other than combination packaging. A packaging that does not require an inner packaging to be capable of performing its containment function and it includes composite packaging.

3.2.8 *shipper, n*—the company or person providing the packaging and instructions for the substances or articles being transported from one location to another.

NOTE 1—Additional packaging terms and definitions are located in 49 CFR Section 171.8 and the UN Orange Book, Section 1.2.1.

4. Significance and Use

4.1 The purpose of this guide is to provide direction for uniform conditioning methodology when conducting special preparations of plastic packagings as prescribed for conducting United Nations (UN) drop test. This guide provides a uniform approach for conditioning of plastic packaging intended for liquid hazardous materials (dangerous goods).

4.2 The hazardous materials (dangerous goods) regulations certification process requires that plastic packagings undergo special preparations before performing the UN drop test. The regulations do not include uniform procedures for conducting special preparations. Non-uniform procedures allow for differences in methods between test facilities which may result in different test results.

4.3 49 CFR 178.603(c) state that special conditioning for drop testing is required for all plastic drums, plastic jerricans, plastic boxes (other than expanded polystyrene boxes), composite packagings (plastic material), and combination packagings with plastic inner packagings (other than plastic bags intended to contain solids or articles). It further states that drop testing shall be conducted when the temperature of the test sample (packagings and contents) has been reduced to –18°C or lower. Test liquids shall be kept in the liquid state, if necessary, by the addition of antifreeze. Water/antifreeze solutions with a minimum 0.95 specific gravity for testing at –18°C or lower are considered acceptable test liquids. These conditioning requirements also apply to IBCs and Large Packagings. Refer to 49 CFR §178.810(b)(4) and §178.965(c), respectively.

4.4 A 24-hour conditioning period *may not* be sufficient time for the packaging and contents to reach the required temperature.

4.5 This guide provides additional information not in the regulations that will facilitate consistent test sample conditioning among test facilities. The information and guidance provided here are intended to meet or exceed the minimum requirements of the regulations.

4.6 For more information on the UN certification tests, refer to Guide **D4919**. For guidance on determining the appropriate fill materials for preparing samples for UN certification testing, refer to Guide **D7887** for liquids and Guide **D8135** for solids materials.

⁷ Available from the International Marine Organization (IMO), 4 Albert Embankment, London, SE1 7SR United Kingdom (website: <http://www.imo.org>).