

White Paper

Research and Development Initiatives on Packaging Testing

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Purpose

The purpose of this paper is to articulate the research efforts completed to date as well as ongoing and future R&D efforts to evaluate and potentially better standardize the various performance-oriented packaging tests of packagings for hazardous materials (HM).

Background

In 1990, the U.S. Department of Transportation (DOT) Research and Special Projects Administration (RSPA), the predecessor of the Pipeline and Hazardous Materials Safety Administration (PHMSA) converted from a system of specification-based packaging to a system of performance-oriented packaging, harmonizing with international organizations such as the United Nations (UN), International Maritime Organization (IMO), and others. This change allows packaging manufacturers greater flexibility in packaging design, leading to more innovative packagings available on the market to better fit the needs of HM fillers and shippers.

To ensure the safety of packagings shipped, PHMSA implemented a series of design qualification tests that every design must pass prior to being authorized for shipment, with specific tests determined by the package design type. These tests, as described in the Hazardous Materials Regulations (HMR), list a number of test parameters that must be followed, however, in many cases, the actual method of performing the tests is left to the tester to determine. This has resulted in a situation where different labs and manufacturers have developed proprietary testing methods that fit with the HMR requirements but vary in a number of details.

Given the variances in the testing methods, the Office of Hazardous Materials Safety (OHMS) initiated a series of studies for FY 2013 to determine the variances and determine if those variances have any effect on the results of the tests. This analysis and potential future efforts will determine the next course of action to better standardize package testing methods.

Analysis

Cold conditioning of intermediate bulk containers (IBC)

Drop testing of IBCs constructed of plastic or with plastic inner receptacles must be conducted when the temperature of the test sample and its contents has been reduced to 0 °F. Different testers have determined different times to performing this conditioning. The proposed research could focus on:

- The differences in conditioning times used by different facilities

- Developing a specific timeframe for uniform conditioning of an IBC and its contents for the drop test
- Establishing uniformity in test method for repeatability

Selection of the corner for combination package drop testing

The HMR require that combination packages must be dropped on a corner, however, it does not indicate which corner should be used, leaving the decision to the individual testers. This can potentially lead to situations where packages are not adequately tested given the shipping environment that nonbulk packages experience. The proposed research could focus on:

- Determining the reliability of test results by evaluating the difference in packaging performance based on drop orientation
- Define “corner drop” more accurately and evaluate how each corner orientation affects test results
- Establishing uniformity in test method for repeatability

Leakproofness test methods and gases

The HMR require that all packages intended to contain liquids must successfully pass a leakproofness test performed with compressed air or other suitable gases. The HMR offers multiple methods by which this test can be performed, but does not specify the gases that may be used, leading to different testers using various methods to perform the test with little uniformity. The proposed research could focus on:

- Evaluating the use of compressed air as a suitable gas
- Determining if other methods beyond those of the HMR for evaluating leakproofness are available
- Evaluating the use of other suitable gases for the leakproofness test
- Establishing uniformity in test method for repeatability

Placement of hydrostatic pressure test fittings

The HMR require a hydrostatic pressure test be performed on all metal, plastic, and composite packaging design types intended to contain liquids. The listed requirements state that the test pressure be taken from the top of the container, but due to the wide variety of packaging designs, placement of fittings for filling, venting, and pressure measurement varies. Different placement of fittings could potentially alter the test results. The proposed research could focus on:

- Determining if varying fitting placement affects test results
- Developing a guide for fitting placement which will result in consistent and reliable hydrostatic pressure test results
- Establishing uniformity in test method for repeatability

Performing testing simultaneously

Several of the HMR-required tests can be performed on multiple samples at once. The HMR do not have any requirements disallowing this, however, this practice could potentially affect test results in ways that could disguise potential failure modes. Specifically, the stack, vibration, hydrostatic pressure, and leakproofness tests can be performed on multiple samples. The proposed research could focus on:

- Determining the effect of simultaneous testing on test results
- Determining if current methods of simultaneous testing are adequate
- Establishing uniformity in test method for repeatability

Summary

There are many tests required by the HMR with little uniformity in their performance across the industry. The variances between test facilities can potentially lead to situations where a package tested in multiple facilities could have different results. Additionally, the HMR have little flexibility in allowing for new testing technologies that may be more appropriate or better perform the tests than those authorized. The proposed research to evaluate the test methods for the various performance-oriented tests will allow OHMS to determine if these methods should be updated and better standardized for more uniform testing across the industry.