HAZARDOUS MATERIAL PACKAGING AND DANGEROUS GOODS COMPLIANCE

Presented by: Patrick Edwards, CDGP
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Purpose and Scope of this Presentation

To provide a brief overview of the Hazardous Material Regulations (HMR) particularly as it relates to Packaging and Package Selection.
Overview of Topics

Hazardous Material Regulations
- Structure and Enforcement
- General Requirements

Package Selection
- Who is Responsible?
- How is a compliant package selected?
- Definitions

Package Preparation and Use

Enforcement Trends and Examples
Dangerous Goods Compliance
-Focus on Packaging-

Selecting the proper package for a dangerous goods shipment can be a challenge. Understanding some of the key factors that should be considered when selecting a packaging will assist in ensuring the proper packaging is used.
It is important to understand that Hazardous Material package selection is **the responsibility of the Hazardous Material Shipper**. This presentation will cover the basic decision points for compliant package selection as well as proper package preparation and use.
It is also beneficial to be aware of enforcement trends that are being seen in the field. We will discuss some broad enforcement trends and then provide some keys to compliance.
LET’S GET STARTED
DOT is responsible for developing and issuing the Hazardous Material Regulation (HMR) which are the regulations that govern the transportation of hazardous materials in interstate, intrastate, and foreign commerce. DOT carries out this responsibility through the Pipeline and Hazardous Materials Safety Administration (PHMSA).
Authority to enforce the HMR is delegated to various agencies within DOT, including PHMSA, FMCSA, FAA, and FRA. The HMR establish standards to promote the safe transport of hazardous materials. These standards include:

- Classification
- Hazard Communication
- Emergency Response Information
- Packaging
- Training of Hazmat Employees
- Transportation
- Incident Reporting.
The HMR is a “restrictive” regulation.

The offering of hazardous materials for transportation in commerce is presumed illegal unless performed in accordance with the regulations.
§171.2(e) No person may offer or accept a hazardous material for transportation in commerce unless the hazardous material is properly classed, described, packaged, marked, labeled, and in condition for shipment as required or authorized by applicable requirements of this subchapter.
Applicability of the Hazardous Materials Regulations (HMR) to persons and functions.

- CFR 49 § 171.1(a) “Packaging Manufacturer”
- CFR 49 § 171.1(b) “Person who offers” (Shipper)
- CFR 49 § 171.1(c) “Carrier” (Transportation functions)

Responsibility for **ALL** hazardous materials transportation functions are assigned to one of these three persons by the regulations.
Responsibility for Package Selection

Package Selection is an important decision point in the course of preparing a hazardous material shipment.

There are many factors to consider in addition to whether or not a package is “authorized” by the HMR.

The HMR is very explicit in its assignment of specific responsibilities. These responsibilities are outlined in 49 CFR §173.22
Responsibility for Package Selection

§173.22 Shipper's Responsibility

- Determine whether a packaging is authorized for the material.
- Close the packaging in conformance with packaging manufacturer’s instructions.
- Retain copies of supplied closing instructions.
- If packaging variations are used, justification must be documented and retained.
Determine the appropriate packaging utilizing the Hazardous Material Basic Description and the Hazardous Material Table in §172.101

The Basic Description consists of:

- Identification Number (UN/NA)
- Proper Shipping Name
- Hazard Class and Division (if applicable)
- Packing Group (if applicable)
Q: What if I don’t know the Basic Description?

A: 49 CFR 172.101(c)(11) states that except for certain materials, you as a Shipper may assign a tentative shipping name, hazard class, and ID # to a hazardous material (including a hazardous waste) based on your knowledge of its characteristics, the hazard precedence found in 49 CFR 173.2(a), and the hazard classes as defined in the HMR. Some additional – relatively simple – compliance requirements are found at 172.101(c)(11)(iv), research these if you wish to use this exemption.
Q: What about the US EPA regulations for hazardous waste?

A: There is a valuable US EPA exclusion from the full regulation of the Resource Conservation and Recovery Act (RCRA) for this type of material.

This exclusion, found in 40 CFR §261.4(d) is for small (<1 gallon) waste characterization samples collected and shipped solely to determine the hazardous waste characteristics or composition. The exclusion applies to any stage of the process of sample collection, temporary storage, shipment, and analysis. As long as you meet the requirements of the exclusion, the sample is not subject to the RCRA regulations for labeling, inspections, personnel training, on-site accumulation time limits, generator status determination, etc. When shipping the sample you must comply with the requirements of the US DOT or if there are none, the requirements of 40 CFR 261.4(d)(2)(ii).
Q. Now that I’ve Classified and Described the material, what’s next?

A. Refer to the Hazardous Material Table in §172.101 and locate the entry related to your material.
### Hazardous Material Table (HMT)

<table>
<thead>
<tr>
<th>Symbols</th>
<th>Proper Shipping Names</th>
<th>Hazard class or Division</th>
<th>ID #</th>
<th>PG</th>
<th>Label Codes</th>
<th>Special provisions (§172.102)</th>
<th>(8)</th>
<th>(9)</th>
<th>(10) Vessel stowage</th>
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<td>(7)</td>
<td>(8A)</td>
<td>(8B)</td>
</tr>
<tr>
<td>Acetal</td>
<td>3</td>
<td>UN1088</td>
<td>II</td>
<td>3</td>
<td>3</td>
<td>IB2, T4, TP1</td>
<td>150</td>
<td>202</td>
<td>242</td>
</tr>
<tr>
<td>Acetaldehyde</td>
<td>3</td>
<td>UN1089</td>
<td>I</td>
<td>3</td>
<td>A3, B16, T11, TP2, TP7</td>
<td>None</td>
<td>201</td>
<td>243</td>
<td>Forbidden</td>
</tr>
<tr>
<td>Acetaldehyde ammonia</td>
<td>9</td>
<td>UN1841</td>
<td>III</td>
<td>9</td>
<td>IB8, IP3, IP7, T1, TP33</td>
<td>155</td>
<td>204</td>
<td>240</td>
<td>200 kg</td>
</tr>
<tr>
<td>Acetaldehyde oxime</td>
<td>3</td>
<td>UN2332</td>
<td>III</td>
<td>3</td>
<td>B1, IB3, T4, TP1</td>
<td>150</td>
<td>203</td>
<td>242</td>
<td>60 L</td>
</tr>
<tr>
<td>Acetone</td>
<td>3</td>
<td>UN1090</td>
<td>II</td>
<td>3</td>
<td>IB2, T4, TP1</td>
<td>150</td>
<td>202</td>
<td>242</td>
<td>5 L</td>
</tr>
<tr>
<td>Acetic acid solution, not less than 50 percent but not more than 80 percent acid, by mass</td>
<td>8</td>
<td>UN2790</td>
<td>II</td>
<td>8</td>
<td>148, A3, A6, A7, A10, B2, IB2, T7, TP2</td>
<td>154</td>
<td>202</td>
<td>242</td>
<td>1 L</td>
</tr>
</tbody>
</table>

49 CFR §172.101
<table>
<thead>
<tr>
<th>Packing Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locate the Packing Instruction in Column 8B or 8C of the HMT.</td>
</tr>
<tr>
<td>Symbols</td>
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<td>(4)</td>
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<tr>
<td>(5)</td>
</tr>
<tr>
<td>(6)</td>
</tr>
</tbody>
</table>
§173.202  Non-bulk packagings for liquid hazardous materials in Packing Group II.

(a) When §172.101 of this subchapter specifies that a liquid hazardous material be packaged under this section, only non-bulk packagings prescribed in this section may be used for its transportation. Each packaging must conform to the general packaging requirements of subpart B of part 173, to the requirements of part 178 of this subchapter at the Packing Group I or II performance level (unless otherwise excepted), and to the particular requirements of the special provisions of column 7 of the §172.101 table.
(b) The following combination packagings are authorized:

**Outer packagings:**
- Steel drum: 1A1 or 1A2
- Aluminum drum: 1B1 or 1B2
- Metal drum other than steel or aluminum: 1N1 or 1N2
- Plywood drum: 1D
- Fiber drum: 1G
- Plastic drum: 1H1 or 1H2
- Wooden barrel: 2C2
- Steel jerrican: 3A1 or 3A2
- Plastic jerrican: 3H1 or 3H2
- Aluminum jerrican: 3B1 or 3B2
- Steel box: 4A
- Aluminum box: 4B
- Natural wood box: 4C1 or 4C2
- Plywood box: 4D
- Reconstituted wood box: 4F
- Fiberboard box: 4G
- Expanded plastic box: 4H1

(c) Except for transportation by passenger aircraft, the following single packagings are authorized:

- Steel drum: 1A1 or 1A2
- Aluminum drum: 1B1 or 1B2
- Metal drum other than steel or aluminum: 1N1 or 1N2
- Plastic drum: 1H1 or 1H2
- Fiber drum: 1G (with liner)
- Wooden barrel: 2C1
- Steel jerrican: 3A1 or 3A2
- Plastic jerrican: 3H1 or 3H2
- Aluminum jerrican: 3B1 or 3B2
- Plastic receptacle in steel, aluminum, fiber or plastic drum: 6HA1, 6HB1, 6HG1 or 6HH1
- Plastic receptacle in steel, aluminum, wooden, plywood or fiberboard box: 6HA2, 6HB2, 6HC, 6HD2 or 6HG2
Packaging Types

Selecting the Proper Packaging for your Hazardous Material Shipment
There are some key definitions in §171.8 of the HMR, related to Hazardous Material Packaging.

It is important to understand these terms in order to select the proper packaging for a Hazardous Material.
Packaging is a receptacle and any other components or materials necessary for the receptacle to perform its containment function in conformance with the minimum packing requirements of the HMR.

Package refers to packaging PLUS its contents.
**Definitions: Combination Packaging**

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

(Example: (4) 1 Gallon bottles in a box)
Definitions:

Single Packaging

**Single packaging** means a non-bulk packaging other than a combination packaging.

**Translation:**
A packaging consisting of an outer packaging with *no inner packagings*  
(Example: 55 Gallon drum).
Definitions: Composite Packaging

**Composite packaging** means a 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; it is filled, stored, shipped and emptied as such.
**Bulk Packaging**

Means a packaging, in which hazardous materials are loaded with no intermediate form of containment.

A Large Packaging in which hazardous materials are loaded with an intermediate form of containment, such as one or more articles or inner packagings, is also a bulk packaging.
Bulk Packaging (Continued)

Additionally, a bulk packaging has:

(1) A **maximum capacity greater than 450 L** (119 gallons) as a receptacle for a liquid.

(2) A **maximum net mass greater than 400 kg** (882 pounds) and a maximum capacity greater than 450 L (119 gallons) as a receptacle for a solid.
Intermediate Bulk Packaging

Intermediate bulk container or IBC means a rigid or flexible portable packaging, other than a cylinder or portable tank, which is designed for mechanical handling.
Non-Bulk Packaging

Means a packaging which has:

1. A maximum capacity of 450 L (119 gallons) or less as a receptacle for a liquid;

2. A maximum net mass of 400 kg (882 pounds) or less and a maximum capacity of 450 L (119 gallons) or less as a receptacle for a solid;

Regardless of the definition of bulk packaging, a maximum net mass of less than 400 kg (882 pounds).

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450L = .45 Cubic Meters = 27,460 cubic inches
Specification packaging means a packaging conforming to one of the specifications or standards for packagings in part 178 or part 179 of this subchapter.
# How to Read a UN Specification Mark

<table>
<thead>
<tr>
<th>THE UNITED NATIONS SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TYPE OF PACKAGE</strong></td>
</tr>
<tr>
<td>1. Drums/Pails</td>
</tr>
<tr>
<td>2. Barrels</td>
</tr>
<tr>
<td>3. Jerricans</td>
</tr>
<tr>
<td>4. Boxes (corrugated)</td>
</tr>
<tr>
<td>5. Bags</td>
</tr>
<tr>
<td>6. Composite Packagings</td>
</tr>
<tr>
<td><strong>MATERIAL OF CONSTRUCTION</strong></td>
</tr>
<tr>
<td>A. Steel</td>
</tr>
<tr>
<td>B. Aluminum</td>
</tr>
<tr>
<td>C. Wood</td>
</tr>
<tr>
<td>G. Fiber (corrugated)</td>
</tr>
<tr>
<td>H. Plastic</td>
</tr>
<tr>
<td><strong>CATEGORY WITHIN TYPE</strong></td>
</tr>
<tr>
<td>1. Closedhead</td>
</tr>
<tr>
<td>2. Openhead</td>
</tr>
<tr>
<td><strong>PACKAGING GROUP FOR WHICH CONTAINER WAS TESTED</strong></td>
</tr>
<tr>
<td>X. for Packaging Group I, II, III</td>
</tr>
<tr>
<td>Y. for Packaging Group II and III</td>
</tr>
<tr>
<td>Z. for Packaging Group III</td>
</tr>
<tr>
<td>• Packaging Group I: Great Danger (high hazard level)</td>
</tr>
<tr>
<td>• Packaging Group II: Medium Danger (medium hazard level)</td>
</tr>
<tr>
<td>• Packaging Group III: Minor Danger (low hazard level)</td>
</tr>
<tr>
<td><strong>DENSITY OR SPECIFIC GRAVITY OF MATERIAL PACKED</strong> (single packagings for liquids) OR . . .</td>
</tr>
<tr>
<td>For packaging intended for Solids or for combination packagings, this marking will indicate the maximum gross mass (weight) in kilograms (for pounds multiply times 2.2)</td>
</tr>
<tr>
<td><strong>HYDRAULIC PRESSURE IN KILO-PASCAL</strong> (kPa) (applies to liquid) OR . . .</td>
</tr>
<tr>
<td>For packaging intended for Solids or for combination packagings, an “S” in upper case will follow the gross mass. Example: UN4G/Y25/S/04/USA/M5586 (this is an example marking for a fiber board box rated for a gross mass of 25kg/55lb.)</td>
</tr>
<tr>
<td><strong>YEAR OF MANUFACTURE</strong></td>
</tr>
<tr>
<td><strong>COUNTRY WHERE ITEM WAS MANUFACTURED</strong></td>
</tr>
<tr>
<td><strong>CODE FOR UN CERTIFYING AGENCY OR MANUFACTURER</strong></td>
</tr>
</tbody>
</table>
Q. The HMT directed me to a Packing Instruction. Does this mean I can use *ANY* of the packaging options listed??

A. Maybe. However, compliance with the general requirements outlined in §173.24 must be determined first.
The HMR define general packaging requirements with which all packaging must comply. These Requirements can be found in §173.24 and §173.24a
§ 173.24  General requirements for packagings and packages.

§ 173.24

Each package used for the shipment of hazardous materials under this subchapter shall be designed, constructed, maintained, filled, its contents so limited, and closed, so that under conditions normally incident to transportation.....
§ 173.24 General requirements for packagings and packages.

- There will be no identifiable release of hazardous materials to the environment;

- The effectiveness of the package will not be substantially reduced; for example, impact resistance, strength, packaging compatibility, etc. must be maintained for the minimum and maximum temperatures, changes in humidity and pressure, and shocks, loadings and vibrations, normally encountered during transportation.
§ 173.24 General requirements for packagings and packages.

- There will be no mixture of gases or vapors in the package which could, through any credible spontaneous increase of heat or pressure, significantly reduce the effectiveness of the packaging;

- There will be no hazardous material residue adhering to the outside of the package during transport.
Compatibility - § 173.24(e)

- Even though certain packagings are specified in this part, it is, nevertheless, the responsibility of the person offering a hazardous material for transportation to ensure that such packagings are compatible with their lading. This particularly applies to corrosivity, permeability, softening, premature aging and embrittlement.

- Packaging materials and contents must be such that there will be no significant chemical or galvanic reaction between the materials and contents of the package.
Now that an Authorized Packaging has been identified, and compliance with the general requirements detailed in 173.24 has been confirmed. Package Selection can be made.
A tested specification packaging configuration is known as a “design type.”

A packaging configuration must be used as it was tested.

**Example:** A box was tested with (4) round plastic bottles, the box must be used for (4) round plastic bottles. (4) square plastic bottles may fit into the box, but would be a violation of the hazardous material regulations and could result in a fine.
Q. How do I find out the “Design Type” for a specification packaging?

In other words, how do I know how the package was tested, so that I can make sure that I use the package properly?

A. The packaging manufacturer or supplier must provide instructions which are known as the “Notification” that outline proper use of the packaging in accordance with §178.2
§178.2 Notification (Closing Instructions)

(c)(1) The manufacturer or other person certifying compliance with the requirements of this part, and each subsequent distributor of that packaging must:

Notify each person to whom that packaging is transferred:

All requirements not met at the time of transfer, and with information specifying the closures, and any other components needed to ensure that the packaging is capable of successfully passing the applicable performance tests. This information must include any procedures to be followed, including closure instructions for inner packagings and receptacles, to effectively assemble and close the packaging for the purpose of preventing leakage in transportation.
Closure instructions must provide for a **consistent and repeatable means of closure** that is sufficient to ensure the packaging is closed in the same manner as it was tested.
Q. Are there any conditions that I can use a tested package differently than how it was tested?

A. Yes, differences that do not meet the definition of a “different packaging” as defined in the HMR are authorized.

Additionally, the regulations outline some “minor” variations that are allowed without further testing.

These variations are found in §178.601(g) in the 49CFR.
(4) A different packaging is one that differs (i.e., is not identical) from a previously produced packaging in structural design, size, material of construction, wall thickness or manner of construction but does not include:

(i) A packaging which differs only in surface treatment. (print, coating, fluorination, etc.)

(ii) A combination packaging which differs only in that the outer packaging has been tested with different inner packagings. A variety of such inner packagings may be assembled in this outer packaging without further testing.

(iii) A plastic packaging which differs only with regard to additives (colorant, UV, anti-stat, etc.)

(iv) A combination packaging with inner packagings conforming to the provisions of paragraph (g) of this section (Packaging Variations)

(v) Packagings which differ from the design type only in their lesser design height.
The selective testing of packagings that differ only in minor respects from a tested type is permitted as described in this section.

There are five selective testing variations:

1, 2, 4 apply to combination packagings.
3, 5 apply to single/composite packagings

All conditions outlined must be met.
All of the general packaging requirements (173.24 and 173.24a) must be met.
Pressure differential capability for air shipments (173.27) is specifically identified as a requirement where applicable.
Variation 1.

Variations are permitted in *inner packagings* of a tested combination package, without further testing of the package, provided an equivalent level of performance is maintained.
Permitted variations are as follows:

(i) Inner packagings of equivalent or smaller size may be used provided—
   (A) The inner packagings are of similar design to the tested inner packagings
   (B) The material of construction of the inner packagings offers resistance to impact and stacking forces equal to or greater than that of the originally tested inner packaging;
   (C) The inner packagings have the same/smaller closure of similar design
   (D) Sufficient additional cushioning material is used to take up void spaces and to prevent significant moving of the inner packagings;
   (E) Inner packagings are oriented in the same manner as in the tested package; and,
   (F) The gross mass of the package does not exceed that originally tested.

(ii) A lesser number of inner packagings, may be used provided sufficient cushioning is added to fill void space(s) and to prevent significant moving of the inner packagings.
Variation 2 – 178.601(g)(2)

Articles or inner packagings of any type, for solids or liquids, may be assembled and transported without testing in an outer packaging under the testing conditions prescribed.
Variation 4 – 178.601(g)(4)

(4) Variation 4. Variations are permitted in outer packagings of a tested design-type combination packaging, without further testing, provided an equivalent level of performance is maintained, as follows:

(i) Reduced external dimensions
(ii) Same material of construction as tested packaging
(iii) The inner packagings and orientation are identical to the tested packaging;
(iv) The same type and amount of absorbent or cushioning as the tested package
(v) Sufficient additional cushioning material is used to take up void spaces and to prevent significant moving of the inner packagings.

An outer packaging qualifying for use in transport in accordance with all of the above conditions may also be used in combination with the Variation 1.
Compliance Trends

PHMSA Inspection Trends

Common Issues Cited During Inspections

- Failure to maintain training records
- Packages not properly marked and labeled
- Incorrect Packaging utilized
- Incorrect shipping papers
- Failure to register with PHMSA
Keys to Packaging Compliance

• Understand your responsibilities as a Hazardous Material Shipper.
• Ensure proper training is provided and training records maintained.
• Identify, Classify, and Describe the hazardous material to be shipped.
• Select an authorized packaging for the hazardous material.
• Prepare the package in accordance with manufacturer’s instructions.
• Ensure that proper closing tools are calibrated and available to responsible personnel.
• Use packaging variations only in accordance with the requirements.
• Document basis for determining “equivalent performance” when using packaging variation 1.
• Properly mark and label packages for shipment.
• Retain copies of closing instructions at least 90 days after shipment.
QUESTIONS?
Thank you for your time and attention. Please do not hesitate to contact me with questions at any time!

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