MODULE 1: About the Program, People & Approach

The People

Who are these guys?
The guy on the left is your trainer for this course, Doug Graham. Doug teaches this course live both at open-enrollment seminars and by request for individual clients on-site at their own facilities, and has since 1993! In fact, Doug heads up our training services that we offer to clients and is a Senior Compliance Advisor at Triumvirate, having joined us in 2006.

That guy on the right is Mark Campanale, Client Relations Manager and New Media Trainer for Triumvirate- you can thank Mark for having to suffer through this program, since he probably, through his black arts, may have helped you find us!

Mark will act as Doug's assistant, student, and facilitator throughout the program- his astute insight into the world of hazardous materials will be a true asset to the program (some sarcasm added).

About Our Approach

When we decided to put this course together, we wanted to offer people all over the country the chance to receive the same quality of training that one would expect from us during a live event. . . . .not some insufferably dull listing of regulatory requirements popping up on a slide while someone with no discernable accent reads cue cards in the background through a drain pipe. This course is actually slightly more detailed than our live course with the added advantage of being able to show some things that are logistically impossible to show you in a live course (like Mark's hat on fire, for example- that type of thing would normally get us in trouble with local fire officials).
The course integrates video instruction, graphics, photographs, and short clips, and dare I say, a touch of humor now and again, mostly to keep you awake during tediously detailed segments.

The material is lengthy, detailed, and at times, complicated, but we try to approach the topics in more of an anecdotal, and explanatory way to try to make it more interesting. Also, we don't simply list the rules, we try to explain them- something that is usually only found in live training.

About the Course Contents and Materials

The course is divided into 12 topic modules, each covering certain aspects of the hazardous materials regulations affecting shippers. Following each module there is a series of review questions- pay attention to those, you may see them again. . . like on the exam at the end.

This companion text serves as both a reference and guidance source to help you with compliance as well as part of your required documentation of course materials.

It is recommended that you print all of the module text and use them as study guides as you take the course. It's a great place to take notes as you go along and you will also see the review questions at the end of each printed module, so you can practice them before your final exam! Go to the Resources menu and select "***TEI Companion Text***" and then download and save the file. . . then print the text to use as a study guide and future reference.

How to Use the Program

We've selected state-of-the-art web-based training software to run this program to try to make your computer experience as user-friendly and intuitive as possible.

The program is self-paced, so you can log on and log off as much as you like and you may take as long as you like to complete the course. The course is designed to be watched in sequence- some modules refer to previous modules or build on knowledge you acquired in previous segments, so you will notice, you may not start the next module until you have completely viewed the previous one, however you can go back and review previously-viewed modules. You can log on from any computer, just remember your user code- that's what gives you the rights to view the course, and it identifies you as a unique individual trainee. Also, the information you supplied when you registered is tied to your user code and is the information that will, in part, appear on your certificate, and in our training database.

When you complete a module, think about and try to answer all of the review questions (it helps to print them out and write down your answers), because some or all will appear on your final exam.

When you have viewed all of the modules and feel confident you know all of the module review questions, it's time to take the exam. DOT requires testing as part of training for hazmat employees, so you cannot complete the course and receive a certificate unless you complete and submit your exam.

How to Ask Questions

You can e-mail Doug to ask a question concerning the course content while using the program. If you have technical questions regarding the use of the program, you can e-mail Mark for technical support. You can also call or e-mail the DOT hazardous materials hotline if you have regulatory questions. All of these contacts appear on your screen.

About Your Certificate of Completion

Once you've taken the final exam and answered all of the questions correctly, you will submit the exam electronically. You will then receive your training certificate and a copy of your completed and corrected exam electronically, which you should then print and retain for your records. If you miss a question on the final exam, DON'T PANIC! . . . .you simply review the module from which the question came (oh yes, the answer is in the presentation), and try again.

Other Useful Things On Your Screen

Module Counter and Completion Indicator
Downloadable DOT Documents
Downloadable Companion Training Text for Note-Taking, Reference and Review
Quick Links to DOT Regulations and PHMSA web site
Trainer Biography

Good Luck, and don't have too much fun. . . .remember, it's still compliance training, after all.

MODULE 2: Intro to Regulations, Applicability & Responsibility

"Hazardous materials" are substances or articles determined by the U.S. Department of Transportation (DOT) to have *inherent characteristics which may pose an unreasonable risk to the public's health and safety, property, or to the environment when transported in commerce*. They include nine categories of hazardous materials to which the regulations apply: explosives, gases, flammable liquids flammable solids, oxidizers, poisons, radioactives, corrosives, and a ninth category known as "Miscellaneous".

Hazardous Materials Transportation Act of 1975

The U.S. Department of Transportation has established regulations for the safe transport of hazardous materials in response to the Hazardous Materials Transportation Act of 1975 (HMTA). The stated purpose of the Act was, "to provide adequate protection against the risks to life and property inherent in the transportation of hazardous material in commerce by improving the regulatory and enforcement authority of the Secretary of Transportation."

This act provided authority for the Secretary of Transportation to draw together previously fragmented regulatory and enforcement authority over the movement of hazardous materials in commerce into one consolidated and coordinated effort.

The Regulations- 49 CFR Parts 100-185, Effective Oct. 1

The regulations pursuant to the HMTA are found in Title 49 of the Code of Federal Regulations, Parts 100-185 (49 CFR §100-185), collectively known as the DOT hazardous materials regulations (HMR). The regulations provide requirements that must be followed by shippers (offerors), carriers, and packaging manufacturers, testers, and reconditioners. These regulations are revised as of October 1 of each year.

Accessing the Regulations

The quickest and easiest way to access the regulations is through the DOT's Pipeline and Hazardous Materials Safety Administration website: www.phmsa.dot.gov. When at the homepage, click on the "Hazmat Safety Community" tab and then select the menu option "Regulations".

Applicability

This course is designed for "*persons who offer*" hazardous materials for transport in commerce and who have "pre-transport functions" as defined in 49 CFR 171.8, that is, a role in properly preparing a shipment of hazardous materials for commercial transport. These individuals may also be commonly referred to as shippers, offerors, or consignors.

Shipper's Responsibility

The shipper (offeror) is responsible for ensuring that the consignment of hazardous material is properly classified, described, packaged, marked, labeled/placarded, and in all respects compliance with the HMR prior to being offered to the carrier for transport. Additionally, the shipper is responsible for ensuring that the shipping paper requirements are fulfilled prior to offering to the carrier.

49CFR vs. ICAO vs. IMDG vs. IATA

In some cases, an alternative set of regulations is used because the shipment is being transported internationally or the carrier, by policy, or membership, follows more restrictive international-based regulations. Here's a summary of what rules to follow when:

- Highway- follow 49 CFR
- Rail- follow 49 CFR
- Domestic air- follow 49 CFR or IATA (if the policy of the air operator)
- International air- follow ICAO or IATA (if the policy of the air operator)
- Domestic water- follow 49 CFR
- International water- follow IMDG

Keep in mind, individual operators may also have additional restrictions and other variations of their own which must be followed.

If you are to follow an alternative shipping code, you still need DOT training, however you will want to seek additional training in the specific requirements of those regulation as well- the DOT will consider that supplemental training to be a function-specific element of the training required under 49 CFR 172, Subpart H, discussed in MODULE 4.

IMDG- International Maritime Dangerous Goods Code
ICAO- International Civil Aviation Organization Technical Instructions
IATA- International Air Transport Association Dangerous Goods Regulations

MODULE 2- Review Questions

1. "*persons who offer*" hazardous materials for transport in commerce are also often referred to as-
    a) Freight forwarders
    b) Consignees
    c) Shippers
    d) Cargo agents

2. The hazardous materials regulations are found in-
    a) 40 CFR Parts 100-185
    b) 49 CFR Parts 100-185
    c) The Hazardous Materials Transportation Act
    d) 29 CFR Part 1910

3. The hazardous materials regulations are revised as of-
    a) October 1 of each year
    b) October 1 of each even-numbered year
    c) January 1 of each year
    d) None of the above

4. An offeror of a hazardous material is responsible for ensuring the shipment is properly-
    a) Packaged
    b) Labeled
    c) Marked
    d) All of the above
    e) Both b and c

5. ICAO references-
    a) The International Conference of Aeronautical Offerings
    b) The Initiative for Civil Air Organization
    c) The International Conference of Aviation Organizations
    d) The International Civil Aviation Organization

MODULE 3: Administrative Requirements

There are several administrative requirements that would impact those responsible for oversight or management of DOT compliance for your employer.

Training

49 CFR 172, Subpart H (172.700-704)

Training is applicable to all "hazmat employees" as defined in 171.8 as a person who is employed on a full-time, part time, or temporary basis by a hazmat employer and who in the course of such employment directly affects hazardous materials transportation safety. These are individuals performing transport or pre-transport functions related to any of the various compliance topics discussed in this course.

Hazmat employees work for employers who may do any or all of the following-

- Transports hazardous materials in commerce;
- Causes hazardous materials to be transported in commerce (for example, preparing hazardous materials to be offered for transport); or
- Designs, manufactures, fabricates, inspects, marks, maintains, reconditions, repairs or tests a package, container, or packaging component that is represented, marked, certified, or sold by that person as qualified for use in transporting hazardous materials in commerce.

Training must include 5 elements-

1. General Awareness
2. Function- Specific- elements specifically applicable to functions performed by hazmat employees and ICAO, IMDG or exemptions, as applicable
3. Safety- emergency response, safe handling, exposure control, avoiding accidents
4. Security Awareness
5. In-Depth Security (for those facilities requiring a written security plan)

Initial training must be performed within 90 days of employment or of beginning hazmat employee activities.

Training must be repeated at least once every 36 months
Documentation of the training must include the name, date, description or copy of the materials, name & address of trainer, and certification of training and testing.

Training records must be retained for duration of employment as a hazmat employee plus 90 days.

Annual Registration

49 CFR 107, Subpart G (107.601-620)

A hazmat employer who anticipates offering or transporting certain categories of hazardous materials must register with the DOT annually before July 1 using Form DOT 5800.2.

Offering or transporting of any of the following types of shipments trigger the applicability of the registration requirement:

1. Highway route-controlled quantity of radioactive material (173.403)
2. >25 kg of explosives having a mass explosion, projectile, or fire hazard (Div. 1.1. 1.2, 1,3)
3. > 1L per package of a Zone A Inhalation Hazard
4. In a packaging exceeding a capacity of 3500 gal (liq) or 13.24 cu m (solids, gases)
5. More than 5,000 lbs (gross) of a single hazard Class that requires placarding
6. A quantity of hazardous material that requires placarding (see MODULE 12 for an explanation of which shipments are placardable). *This category was added beginning July 1, 2000.*

The registration form and instructions are available on the www.phmsa.dot.gov website.

Fees for registration are based upon the hazmat employer's status as a small business, non-small business, and/or non-profit entity. Current fee schedule is described in the instructions.

The registration year begins on July 1 and ends on June 30. The registration and associated fee is due before the registration year begins (by June 30 deadline).

Once an employer registers, they receive back a certificate of registration which must be retained on file. Additionally, hazardous materials transporters must carry a copy of the current certificate on the vehicle.

Registration may be done on-Line or by mail and employers may register for 1 or 3 years. Corporations may submit one registration for multiple facilities.

Employers who failed to register for previous years, must retroactively register for each year that was missed and pay the associated fee that was in effect at the time. The instructions show the fee structure for previous registration years.

Security Planning

49 CFR 172, Subpart I (172.800-822)

Adopted in the fall of 2003 due to the increased awareness of terrorism threats in the wake of the September 11, 2001 attacks, the security planning rule set forth new requirements for specific categories of shippers and carriers. This rule was implemented in order to minimize terrorism risks related to acutely dangerous categories and large quantities of hazardous materials.

Applicability-

A written security plan must be developed and implemented by both shippers and carriers of the following categories of materials:

(1) Any quantity of a Division 1.1, 1.2, or 1.3 material;

(2) A quantity of a Division 1.4, 1.5, or 1.6 material requiring placarding in accordance with Sec. 172.504(c);

(3) A large bulk quantity*of Division 2.1 material;

(4) A large bulk quantity of Division 2.2 material with a subsidiary hazard of 5.1;

(5) Any quantity of a material poisonous by inhalation, as defined in Sec. 171.8 of this subchapter;

(6) A large bulk quantity of a Class 3 material meeting the criteria for Packing Group I or II;

(7) A quantity of a desensitized explosives meeting the definition of a Division 4.1 or Class 3 material requiring placarding in accordance with Sec. 172.504(c);

(8) A large bulk quantity of a Division 4.2 material meeting the criteria for Packing Group I or II;

(9) Any quantity of a Division 4.3 material;

(10) A large bulk quantity of a Division 5.1 material in Packing Groups I and II; perchlorates; or ammonium nitrate, ammonium nitrate fertilizers, or ammonium nitrate emulsions, suspensions, or gels;

(11) Any quantity of organic peroxide, Type B, liquid or solid, temperature controlled;

(12) A large bulk quantity of Division 6.1 material (for a material poisonous by inhalation see paragraph (5) above);

(13) A select agent or toxin regulated by the Centers for Disease Control and Prevention under 42 CFR part 73 or the United States Department of Agriculture under 9 CFR part 121;

(14) A quantity of uranium hexafluoride requiring placarding under Sec. 172.505(b);

(15) International Atomic Energy Agency (IAEA) Code of Conduct Category 1 and 2 materials including Highway Route Controlled quantities as defined in 49 CFR 173.403 or known as radionuclides in forms listed as RAM-QC by the Nuclear Regulatory Commission;

(16) A large bulk quantity of Class 8 material meeting the criteria for Packing Group I.

**Note: As used in this section, ``large bulk quantity'' refers to a quantity greater than 3,000 kg (6,614 pounds) for solids or 3,000 liters (792 gallons) for liquids and gases in a single packaging such as a cargo tank motor vehicle, portable tank, tank car, or other bulk container.*

Plan Structure and Required Elements-

Security plans require a hazmat employer to address the security risks of these materials in 3 areas.

- Facility (unauthorized access)
- Personnel
- En-Route

The employer then addresses those risks and forms a written plan to minimize those risks. Although the planning requirements are not prescriptive and allow employers flexibility in adopting risk minimization strategies, there are specific plan elements and policies that are required, including:

1) There must be a senior management official identified who is responsible for development and implementation of the plan;
2) The plan must identify security duties for each position or department responsible for implementing all or part of the plan;
3) The plan must describe the process for notifying employees when plan elements are to be implemented; and
4) The plan must be in writing, retained (paper or electronic), available to employees responsible for implementing it, updated as necessary, reviewed annually, and made available to the DOT for inspection, upon request.

Security Training-

General awareness security training is given to all hazmat employees (even if not required to have a plan) whenever hazardous materials training is provided.

Those facilities requiring a written security plan must also provide in-depth security training specific to the written plan to only those hazmat employees who have security roles or other responsibilities impacted by the plan.

SSI Rule-

Plans may be considered, Sensitive Security Information according to the Transportation Safety Administration and subject to distribution and marking rules of 49 CFR 1520.

There is a specific webpage devoted to security planning on the PHMSA hazardous materials webpage: http://phmsa.dot.gov/hazmat/security.

Special Permits (Exemptions)

49 CFR 107, Subpart B (107.101-127)

The Pipeline and Hazardous Materials Safety Administration (PHMSA) has the primary responsibility for the issuance of DOT Special Permits (previously known as "exemptions") and Authorizations to the hazardous materials regulations. A Special Permit is a document which authorizes a person to perform a function that is not currently authorized in the regulations. Also, in many instances, the regulations require approvals and/or registrations prior to transportation in commerce.

The requirements for applying for a new special permit, or for being named as a party to an existing special permit, are described in 49 CFR 107.101 through 127. They include issues such as procedures for application, public notice and review, obtaining party status, and the time frame associated with submitting such requests.

If you have any questions, the PHMSA can be contacted at the Office of Hazardous Materials Special Permits and Approvals 202-366-4535. There is also a webpage dedicated to this office and topic on the PHMSA hazardous materials webpage: http://phmsa.dot.gov/hazmat/regs/sp-a

Enforcement

49 CFR 107, Subpart D (107.301-331)

The DOT enforces the hazardous materials regulations through various administrations under its umbrella, specifically, for Highway Shipments- the Federal Motor Carrier Safety Administration (FMCSA); for rail – the Federal Railroad Administration (FRA); for air- the Federal Aviation Administration (FAA); for water- the U.S. Coast Guard (USCG); and issues related to packaging, Approvals and Special Permits- the Pipeline and Hazardous Materials Safety Administration (PHMSA).

Part 107, Subpart D describes the rules and procedural issues related to enforcement. Those include:

- The mechanisms of enforcement, such as warning letters, tickets, and notices of probable violation (107.309-311);
- Procedures for reply, admission of violation, informal response, hearing request, hearing, administrative law judge decisions, appeals, and compromise and settlement (107.313-327).
- Penalties, including civil violations ranging from $250 up to $55,000 ($110,000 if death, serious injury or illness, or substantial destruction of property resulted) (107.329); and
- Frequently cited violations and baseline assessments (107, App. A).

Incident Reporting

49 CFR 171.15-16

Immediate Notice of Certain Hazmat Incidents (171.15)

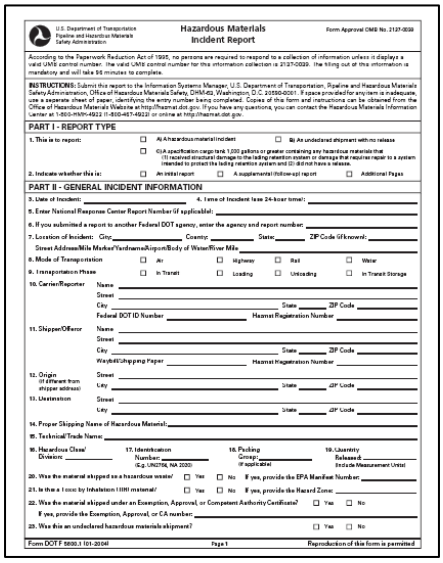
The person in physical possession of the hazardous material at the time of hazardous material transportation incident resulting from hazardous materials involvement must as soon as practical, but no later than 12 hours after occurrence, report the incident to the National Response Center (NRC) 1 800-424-8802. 49 CFR 171.15 describes the information that must be provided by the caller.

The telephone report is required whenever any of the following occurs during the course of transportation in commerce (including loading, unloading, and temporary storage) and as a direct result of a hazardous material—

- A person is killed;
- A person receives an injury requiring admittance to a hospital;
- The general public is evacuated for one hour or more;
- A major transportation artery or facility is closed or shut down for one hour or more; or
- The operational flight pattern or routine of an aircraft is altered;
- Fire, breakage, spillage, or suspected radioactive contamination occurs involving a radioactive material (see also §176.48 of this subchapter);
- Fire, breakage, spillage, or suspected contamination occurs involving an infectious substance other than a regulated medical waste;
- A release of a marine pollutant occurs in a quantity exceeding 450 L (119 gallons) for a liquid or 400 kg (882 pounds) for a solid;
- A situation exists of such a nature (*e.g.*, a continuing danger to life exists at the scene of the incident) that, in the judgment of the person in possession of the hazardous material, it should be reported to the NRC; or
- During transportation by aircraft, a fire, violent rupture, explosion or dangerous evolution of heat (*i.e.* , an amount of heat sufficient to be dangerous to packaging or personal safety to include charring of packaging, melting of packaging, scorching of packaging, or other evidence) occurs as a direct result of a battery or battery-powered device.

Detailed Hazmat Incident Report (171.16)

Each person in physical possession of a hazardous material at the time that any of the following incidents occurs during transportation (including loading, unloading, and temporary storage) must submit a Hazardous Materials Incident Report on DOT Form F 5800.1 within 30 days of discovery of the incident:



U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration

Hazardous Materials Incident Report

Form Approved OMB No. 2137-0039

According to the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 2137-0039. The filling out of this information is mandatory and will take 90 minutes to complete.

INSTRUCTIONS: Submit this report to the Information Systems Manager, U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration, Office of Hazardous Materials Safety, DHM-63, Washington, D.C. 20590-0001. If space provided for any item is inadequate, use a separate sheet of paper, identifying the entry number being completed. Copies of this form and instructions can be obtained from the Office of Hazardous Materials Website at http://hazmat.dot.gov. If you have any questions, you can contact the Hazardous Materials Information Center at 1-800-HMR-4922 (1-800-467-4922) or online at http://hazmat.dot.gov.

PART I - REPORT TYPE

1. This is to report: ☐ (a) A hazardous material incident ☐ (b) An undeclared shipment with no release
☐ (c) A specification cargo tank 1,000 gallons or greater containing any hazardous materials that (1) received structural damage to the lading retention system or damage that requires repair to a system intended to protect the lading retention system and (2) did not have a release.

2. Indicate whether this is: ☐ An initial report ☐ A supplemental (follow-up) report ☐ Additional Pages

PART II - GENERAL INCIDENT INFORMATION

3. Date of Incident: _____ 4. Time of Incident (use 24-hour time): _____

5. Enter National Response Center Report Number (if applicable): _____

6. If you submitted a report to another Federal DOT agency, enter the agency and report number: _____

7. Location of Incident: City: _____ County: _____ State: _____ ZIP Code (if known): _____
Street Address/Mile Marker/Yardname/Airport/Body of Water/River Mile _____

8. Mode of Transportation ☐ Air ☐ Highway ☐ Rail ☐ Water

9. Transportation Phase ☐ In Transit ☐ Loading ☐ Unloading ☐ In Transit Storage

10. Carrier/Reporter
Name _____
Street _____
City _____ State _____ ZIP Code _____
Federal DOT ID Number _____ Hazmat Registration Number _____

11. Shipper/Offeror
Name _____
Street _____
City _____ State _____ ZIP Code _____
Waybill/Shipping Paper _____ Hazmat Registration Number _____

12. Origin (if different from shipper address)
Street _____
City _____ State _____ ZIP Code _____

13. Destination
Street _____
City _____ State _____ ZIP Code _____

14. Proper Shipping Name of Hazardous Material: _____

15. Technical/Trade Name: _____

16. Hazardous Class/Division _____ 17. Identification Number: _____ (e.g. UN2794, NA 2030) 18. Packing Group (if applicable) _____ 19. Quantity Released (include Measurement Units) _____

20. Was the material shipped as a hazardous waste? ☐ Yes ☐ No If yes, provide the EPA Manifest Number: _____

21. Is this a ☐ toxic by inhalation (TIH) material? ☐ Yes ☐ No If yes, provide the Hazard Zone: _____

22. Was the material shipped under an Exemption, Approval, or Competent Authority Certificate? ☐ Yes ☐ No
If yes, provide the Exemption, Approval, or CA number: _____

23. Was this an undeclared hazardous materials shipment? ☐ Yes ☐ No

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- Any of the circumstances requiring immediate notification by telephone;
- An unintentional release of a hazardous material or the discharge of any quantity of hazardous waste;
- A specification cargo tank with a capacity of 1,000 gallons or greater containing any hazardous material suffers structural damage to the lading retention system or damage that requires repair to a system intended to protect the lading retention system, even if there is no release of hazardous material;
- An undeclared hazardous material is discovered; or
- A fire, violent rupture, explosion or dangerous evolution of heat (*i.e.* , an amount of heat sufficient to be dangerous to packaging or personal safety to include charring of packaging, melting of packaging, scorching of packaging, or other evidence) occurs as a direct result of a battery or battery-powered device.

Additional specific reporting related to recordkeeping, air incidents, and updating reports are also found in 171.16.

For more information regarding incidents and to access Form DOT 5800.1 and instructions, go to the incident reporting webpage: http://phmsa.dot.gov/hazmat/incident-report.

MODULE 3- Review Questions

1. A "*hazmat employee*" -
   a) Affects transportation safety
   b) Are always employed by carriers
   c) Are never employed by carriers
   d) Could be a part-time or temporary employee
   e) Both a and d

2. Hazmat employees must be trained-
   a) Upon initial assignment
   b) Within 90 days of employment
   c) At a minimum, every 24 months
   d) All of the above

3. Annual registration is required for those who offer or transport-
   a) Any radioactive material
   b) A quantity of hazardous material that requires placarding
   c) Flammable or non-flammable gases
   d) Any quantity of explosives
   e) Both b and d

4. A written hazardous material security plan must include -
   a) Background checks of all hazmat employees
   b) A facility alarm system
   c) Methods to address facility, personnel and en-route security risks
   d) All of the above

5. A special permit -
   a) Is an alternative method of shipment available to intrastate carriers
   b) A transporter license issued for interstate transport
   c) A document authorizing a function not authorized in the regulations
   d) All of the above

6. Enforcement is described in 49 CFR Part 107, Subpart D and includes-
   a) Penalties and baseline assessments
   b) Mechanisms of enforcement
   c) Procedures to be followed following an enforcement action
   d) All of the above

7. An immediate notice by phone of a hazmat incident is required when, as a direct result of hazardous materials during transport -
   a) A major transportation artery is closed for one hour or more
   b) A person is required to be admitted into a hospital due to injury
   c) An undeclared hazardous material is discovered
   d) All of the above
   e) Both a and b

MODULE 4: Hazard Classification & Packing Group Assignment

The first step in the process of preparing a hazardous material for transport is identifying the material and determining what hazard, or hazards, are associated with the material.

The DOT has identified nine categories of material that pose a risk during transportation and therefore meet the definition of a hazardous material. Each category is referred to as a "Hazard class". Five of those hazard classes are further sub-divided into "Divisions". This classification system is summarized in 49 CFR 173.2.

Hazard Class & Division Overview

49 CFR 173.2

The following summarizes the hazard classes and divisions identified as hazardous material. It is crucial that the offeror understand how these categories are defined. The regulatory reference to the right of each category identifies the part and section of the 49 CFR that describes in detail the criteria used to define each hazardous material type. We will look in detail at each category.

Class	Name	Division	Division Name	Reference Sec.
1	Explosives	1.1	Explosives with a Mass Explosion Hazard	173.50
		1.2	Explosives with a Projection Hazard	173.50
		1.3	Explosives with a Predominant Fire Hazard	173.50
		1.4	Explosives with No Significant Blast Hazard	173.50
		1.5	Very Insensitive Explosives; Blasting Agents	173.50
		1.6	Extremely Insensitive Detonating Substances	173.50
2	Gases	2.1	Flammable Gas	173.115
		2.2	Non-Flammable Compressed Gas	173.115
		2.3	Gas Poisonous by Inhalation	173.115
3	Flammable Liquids	_		173.120
4	Flammable Solids	4.1	Flammable Solid	173.124
		4.2	Spontaneously Combustible Material	173.124
		4.3	Dangerous When Wet Material	173.124
5	Oxidizers	5.1	Oxidizers	173.128
		5.2	Organic Peroxide	173.128
6	Poisons (Toxics)	6.1	Poisonous Materials (Toxic Materials)	173.132
		6.2	Infectious Substances	173.134
7	Radioactives	_		173.403
8	Corrosives	_		173.136
9	Miscellaneous	_		173.140

Hazard Definition Criteria

49 CFR 173.50-144, 173.403

We will walk through each Class and Division of hazardous material in sequence and discuss how DOT defines each, starting with explosives.

Explosives- *Class 1, Divisions 1.1-1.6 (173.50)*

Explosives must be tested, classified and approved by the Assoc Administrator for Hazardous Materials Safety. Explosives are sub-categorized into six Divisions, based upon the specific explosive hazard presented, as follows:

1.1- Mass explosion hazard (would affect the entire load)
1.2- Projection hazard
1.3- Fire hazard & may also pose a minor blast or projection hazard
1.4- Minor explosion hazard (would be largely confined to the package)
1.5- Very insensitive explosive (presents a mass explosion hazard, but with very little probability of initiation, or detonation from burning)
1.6- Extremely insensitive explosive (and with no mass explosion hazard)

To avoid certain types of explosives from being stored or transported together, where the combination might increase the hazard, the DOT also further assigns a compatibility grouping to each explosive. A **compatibility group** is designated as a capital letter: A, B, C, D, E, F, G, H, J, K, L, N, or S. 49 CFR 173.52- Table 1 describes the specific characteristics of each of the thirteen recognized compatibility groups.

Whenever an explosive is described, both the Division and compatibility group must be identified. There are 35 different Division and compatibility group combinations (known as classification codes). An example of a classification code: 1.4D.

Gases- *Class 2, Div. 2.1-2.3 (173.115)*

Gases are defined as materials which are in a gaseous state at a standard temperatures and pressures (described in 173.115(a)-(c)). There are three Divisions of gases- flammable, non-flammable, and those poisonous by inhalation, as described below:

2.1- Flammable gas-
A flammable gas is defined as having a lower explosive limit at or below 13% at a standardized temperature and pressure, having a flammable range in air of at least 12%, or being a flammable aerosol as defined in 173.115(k).

2.2- Non-flammable gas-
A Division 2.2 gas is a non-flammable, nonpoisonous compressed gas—including compressed gas, liquefied gas, pressurized cryogenic gas, compressed gas in solution, asphyxiant gas and oxidizing gas.

2.3- Gas poisonous by inhalation (Toxic gas)-
A gas that is poisonous by inhalation is defined as being known to be so toxic to humans as to create a health hazard during transport, or has an established median lethal concentration (LC50) of no greater than 5,000 parts per million in air. Toxic gases are further divided into four Hazard Zones based upon the LC50 range.

Hazard Zone assignment:

A toxic gas must also be assigned the appropriate hazard zone letter. These zone designations identify the relative danger of toxic gases. 49 CFR 173.116 describes the assignment of hazard zones based upon the LC50 of the gas as follows:

Hazard zone	Inhalation toxicity
A	LC_{50} less than or equal to 200 ppm.
B	LC_{50} greater than 200 ppm and less than or equal to 1000 ppm.
C	LC_{50} greater than 1000 ppm and less than or equal to 3000 ppm.
D	LC_{50} greater than 3000 ppm or less than or equal to 5000 ppm.

***Flammable liquids**- Class 3 (173.120)*

3- A Flammable liquid is defined as having a flash point temperature at or below **140°F** (60°C); or a liquid with a flash point at or above 100°F that is intentionally heated and offered for transport at or above its flashpoint temperature in a bulk packaging.

Flashpoint is defined in 173.120(c) as "the minimum temperature at which a liquid gives off a vapor within a test vessel in sufficient concentration to form an ignitable mixture with air near the surface of the liquid. Test methods for determining flashpoint are described in 173.120(c)(1).

***Flammable solids-** Class 4, Div. 4.1-4.3 (173.124)*

4.1- A Flammable solid includes: desensitized explosives, self-reactive solids, and readily combustible solids.

Self-reactive materials are materials that are thermally unstable and that can undergo a strongly exothermic decomposition even without participation of oxygen (air). Those having technical names are organized into generic types according to the self-reactive substances table in 173.224. One not listed by name in the self-reactive substances table, is assigned one of seven generic types (*Type A-G*), depending upon the specific properties of the material.

Readily combustible solids include those which can cause fire through friction, those which burn at a rapid rate, and flammable metal powders.

Test methods for all Division 4.1 materials can be found in the *UN Manual of Tests and Criteria*.

4.2- Spontaneously combustible materials fall into one of two categories- pyrophorics and self-heating solids. Pyrophorics are defined as being a liquid or solid that, without an external ignition source, can ignite within 5 minutes of coming in contact with air. A self-heating material is a material that, when in contact with air and without an energy supply, is liable to self-heat.

Test methods for pyrophorics and self-heating materials can be found in the *UN Manual of Tests and Criteria*.

4.3- Dangerous when wet- material means a material that, by contact with water, is liable to become spontaneously flammable or to give off flammable or toxic gas at a rate greater than 1 L per kilogram of the material, per hour, when tested in accordance with UN Manual of Tests and Criteria.

Oxidizers- *Class 5, Div. 5.1-5.2 (173.127)*

5.1- An Oxidizer, as defined, may cause or enhance the combustion of other materials, generally by the yielding of oxygen. Based upon a UN test method for relative burn time.

5.2- An Organic peroxide is defined as an organic compound having a bivalent -O-O-. Organic peroxides can be unstable and may need to be temperature controlled. Organic peroxides not listed by name are assigned the name "Organic peroxide, Type G" through "Type A", designating increasing levels of instability.

The testing methods used to identify oxidizers are found in the UN Manual of Tests and Criteria.

Poisons- *Class 6, Div. 6.1 (173.132) -6.2 (173.134)*

6.1- A Poisonous (Toxic) material- is defined as one known to be so toxic to humans to create a health hazard during transport , or those having a median lethal dose (LD50) below a specific value. The LD50 may be based upon oral (ingestion), or dermal (absorbtion), toxicity. Additionally, a dust, mist or vapor may be toxic based upon the median lethal concentration in air (LC50), expressed in parts per million (ppm) or milligrams per liter of air (mg/L).

The lethal dose and concentration values that define a poison are: a liquid or solid material that has an oral LD50 $\leq$ 300 mg/kg (not more than 300

milligrams per kilogram of body weight); dermal LD50 ≤ 1000 mg/kg; or LC50 <5000 ppm (vapor), ≤ 4 mg/L (dust and mist).

6.2- Infectious substances are those materials known or reasonably expected to contain a pathogen, that is, a micro-organism(s) capable of causing disease in humans or animals. Infectious substances are organized into two categories- A and B, which denote the relative degree of danger associated with the pathogen. Additionally, Division 6.2 includes biological, medical, and clinical waste.

Category A materials are capable of causing permanent disability or a life-threatening or fatal disease.

Category B materials are defined as not being in Category A, but still capable of causing disease in humans or animals.

173.134 contains numerous exceptions which may exclude specific materials from the definition of an infectious substance, or may contain specific provisions and exceptions from certain elements of the regulations. These exceptions include those for medical, clinical and biological wastes, non-pathogenic micro-organisms, low probability materials, blood, dried blood spots, sewage, patient diagnostic specimens, pathogens rendered inactive, contaminated laundry, contaminated equipment, corpses, non-infectious biological materials, and FDA-approved final form biological products.

Radioactives- *Class 7- (173.403)*

7- A radioactive material, as defined, means- any material containing radionuclides where both the activity concentration and the total activity in the consignment exceed the values in Table 173.436 or the values derived according to the instructions in 173.433.

Note: If you don't have a background in radiation safety, find someone who does- this is an expertise and you may need to get a radiation safety officer (RSO), or other person knowledgeable in radioactive materials, involved. The radioactives regulations are very complex, however, all the principles of compliance are the same- classification, use of the hazardous materials table, packaging, labeling, marking, placarding, and shipping papers. Radioactives often have very unique requirements within each of these compliance areas, and you may need an RSO to interpret the various provisions for you.

***Corrosives**- Class 8 (173.136)*

8- A corrosive material is defined as a liquid or solid that causes full thickness destruction of human skin at the site of contact within a specified period of time. Additionally, a material that could become liquid during transport,and that has a severe corrosion rate to steel or aluminum (as described in 173.137(c)(2)), is also included in the definition of a corrosive.

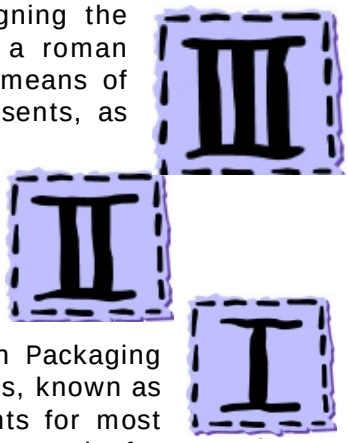
***Class 9-** Miscellaneous (173.140)*

9- Some materials do not meet the definition of hazard classes 1-8, but still may a risk during transport- these materials fall into Class 9- Miscellaneous.

A Miscellaneous material is defined as-
1) having anesthetic, noxious or similar properties which could cause extreme annoyance or discomfort to a flight crew member so as to not be able to correctly perform their assigned duties; 2) meeting the definition of an elevated temperature material, hazardous waste, hazardous substance, or marine pollutant; or 3) being specifically listed in the hazardous materials table (172.101) as a class 9 (examples include: dry ice, asbestos, and first aid kits).

Packing Group Assignment Criteria

49 CFR 173.120-144



The next step in describing a hazardous material is assigning the proper packing group, if applicable. A packing group is a roman numeral designation applied to hazardous materials as a means of expressing the relative degree of danger the material presents, as follows:

I- High
II- Medium
III- Low

Packing groups were developed when the UN-Specification Packaging Standard was adopted as part of the sweeping 1993 revisions, known as HM-181. The UN Standard established testing requirements for most non-bulk packagings (e.g., drums, boxes, jerricans), and for intermediate bulk pacackaging (totes, yard boxes), and is discussed in detail in MODULE 8 of this program.

There are three levels of testing under the UN Standard, wherein packagings are tested more vigorously if they are to be acceptable for hazardous materials having a higher level of danger. The three levels are indicated as part of the test marking on the packaging as follows-

X- Tested for Packing Group I, II, or III materials
Y- Tested for Packing Group II or III materials
Z- Tested for Packing Group III materials

How to Assign a Packing Group

It is important that the offeror of a hazardous material properly assign the applicable packing group as part of the classification process. Packing groups apply to Class 3, 4, 5, 6, 8, and some Class 9 materials. The sections of the regulations that define the Hazard Classes and Divisions (discussed at the start of this MODULE), also describe the packing group criteria for each.

Below is a summary of the defining criteria and relevant sections for packing groups of each Class/Division:

Class or Division	**Basis for Packing Group Assignment**	**Regulatory Reference**
3	Flash point and boiling point range PG I- FP $\leq$ 140 F and B.P $\leq$ 95 F PG II- FP < 73 F PG III- FP $\geq$ 73, $\leq$140 F	173.121
4.1	For readily combustible solids- burn rate	173.125(b)
4.2	Pyrophoric liquids and solids are assigned PG I	173.125(c)(1)
4.2	For self-heating materials- combination of positive test result & package volume	173.125(c)(2)
4.3	Specific reaction to water	173.125(d)
5.1	For solids- mean burning time compared to a standard mixture For liquids- Spontaneous ignition with nitrocellulose or mean pressure rise as compared to specific standards.	173.127(b)(1) 173.127(b)(2)
5.2	As assigned in the hazardous materials type based upon assigned shipping name and generic type	173.129
6.1	LD50 and LC50 ranges	173.133
6.2	As assigned in the hazardous materials table based upon shipping name	173.134(a)(1)
8	Tissue exposure and corresponding destruction times	173.137
9	As assigned in the hazardous materials table based upon shipping name	173.141

Classification of Materials with Multiple Hazards

49 CFR 173.2a

Hazard Ranking List- 173.2a(a)

A material that meets the definition of more than one hazard class or division must be classed according to the highest ranking hazard class in the following ranking list.

(1) Class 7 (radioactive materials, other than limited quantities).

(2) Division 2.3 (poisonous gases).

(3) Division 2.1 (flammable gases).

(4) Division 2.2 (nonflammable gases).

(5) Division 6.1 (poisonous liquids), Packing Group I, poisonous-by-inhalation only.

(6) A material that meets the definition of a pyrophoric material in §173.124(b)(1) of this subchapter (Division 4.2).

(7) A material that meets the definition of a self-reactive material in §173.124(a)(2) of this subchapter (Division 4.1).

(8) Class 3 (flammable liquids), Class 8 (corrosive materials), Division 4.1 (flammable solids), Division 4.2 (spontaneously combustible materials), Division 4.3 (dangerous when wet materials), Division 5.1 (oxidizers) or Division 6.1 (poisonous liquids or solids other than Packing Group I, poisonous-by-inhalation). The hazard class and packing group for a material meeting more than one of these hazards shall be determined using the precedence table in paragraph (b) of this section.

(9) Combustible liquids.

(10) Class 9 (miscellaneous hazardous materials).

For example, if a material is both pyrophoric and a flammable liquid, then the material becomes a Division 4.2 with a subsidiary hazard of 3 since a Division 4.2 pyrophoric liquid is ranked higher on the list than a Class 3 flammable liquid.

Precedence of Hazard Table- 173.2a(b)

A material that meets the definition of more than one hazard which are each evenly ranked together in group (8) on the above ranking list, must then be compared on the Precedence of Hazard Table. The intersection of the two hazards on the table indicates the hazard class (primary hazard), whereas the hazard that does not appear in the intersection becomes the subsidiary hazard.

For example, if a material is both a medium hazard flammable liquid (3, II) and a medium hazard corrosive liquid (8, II), then the material becomes a Class 3 with a subsidiary hazard of 8 since Class 3 is shown at the intersection of the two.

Precedence of Hazard Table

	4.2	4.3	5.1 I[1]	5.1 II[1]	5.1 III[1]	6.1, I dermal	6.1, I oral	6.1 II	6.1 III	8, I liquid	8, I solid	8, II liquid	8, II solid	8, III liquid	8, III solid
3 I[2]		4.3				3	3	3	3	3	([3])	3	([3])	3	([3])
3 II[2]		4.3				3	3	3	3	8	([3])	3	([3])	3	([3])
3 III[2]		4.3				6.1	6.1	6.1	[3][4]	8	([3])	8	([3])	3	([3])
4.1 II[2]	4.2	4.3	5.1	4.1	4.1	6.1	6.1	4.1	4.1	([3])	8	([3])	4.1	([3])	4.1
4.1 III[2]	4.2	4.3	5.1	4.1	4.1	6.1	6.1	6.1	4.1	([3])	8	([3])	8	([3])	4.1
4.2 II		4.3	5.1	4.2	4.2	6.1	6.1	4.2	4.2	8	8	4.2	4.2	4.2	4.2
4.2 III		4.3	5.1	5.1	4.2	6.1	6.1	6.1	4.2	8	8	8	8	4.2	4.2
4.3 I			5.1	4.3	4.3	6.1	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
4.3 II			5.1	4.3	4.3	6.1	4.3	4.3	4.3	8	8	4.3	4.3	4.3	4.3
4.3 III			5.1	5.1	4.3	6.1	6.1	6.1	4.3	8	8	8	8	4.3	4.3
5.1 I[1]						5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
5.1 II[1]						6.1	5.1	5.1	5.1	8	8	5.1	5.1	5.1	5.1
5.1 III[1]						6.1	6.1	6.1	5.1	8	8	8	8	5.1	5.1
6.1 I, Dermal										8	6.1	6.1	6.1	6.1	6.1
6.1 I, Oral										8	6.1	6.1	6.1	6.1	6.1
6.1 II, Inhalation										8	6.1	6.1	6.1	6.1	6.1
6.1 II, Dermal										8	6.1	8	6.1	6.1	6.1
6.1 II, Oral										8	8	8	6.1	6.1	6.1
6.1 III										8	8	8	8	8	8

MODULE 4- Review Questions

1. An explosive that presents a fire hazard and a minor blast hazard is a-
    a) Division 1.3
    b) Division 1.4
    c) Division 1.3 or 1.4
    d) Division 4.1

2. A gas poisonous by inhalation with an LC50 of 325 ppm falls within-
    a) Hazard Zone A
    b) Hazard Zone B
    c) Hazard Zone C
    d) Hazard Zone D
    e) None of the above

3. A flammable liquid with a flash point of 28°F and a boiling point of 92°F is a-
    a) Division 1.3
    b) Class 3, Packing Group I
    c) Class 3, Packing Group II
    d) Class 3, Packing Group III
    e) Division 3.1

4. A Division 4.1 includes-
    a) Pyrophorics
    b) Desensitized explosives
    c) Self-reactive solids
    d) All of the above
    e) Both b and c

5. A Division 5.1 oxidizer
    a) Are often temperature controlled
    b) May cause or enhance the combustion of other materials
    c) Contain a bivalent O-O oxygen configuration
    d) All of the above

6. Infectious substances include
    a) Regulated medical waste
    b) Nuclear medicine waste
    c) Category C clinical specimens
    d) All of the above

7. A corrosive is defined based upon-
    a) Severe corrosion to steel or aluminum
    b) Skin destruction
    c) pH range
    d) All of the above
    e) Both a and b

MODULE 5: Shipping Names & the Hazardous Materials Table

The Hazardous Materials Table (HMT) of 172.101 lists all of the materials by name that are regulated by DOT as hazardous.

The offeror is responsible for assigning the proper shipping name to the hazardous material being offered. The shipping name, as shown in column 2 of the HMT, is the basis by which many other compliance determinations are made. Getting the shipping name wrong may result in many additional aspects of the shipment being out of compliance, therefore is vitally important this be done correctly.

Shipping Name Selection Criteria

49 CFR 172.101(c)

Rule Number 1: Remember your homework! In the previous MODULE, we discussed how to classify and assign packing groups to a hazardous material. This must be done before shipping names are investigated. If a shipping name is not listed in the hazardous materials table (Table) with the hazard class/division and packing group that had been assigned to the material by the offeror, then it's not the correct name.

So, now that we've done our hazard class and packing group homework, let's talk about the rules governing shipping name selection. It should also be noted that having experience in this area and familiarity with the entries in the Table, or working closely with someone who does, can make this a much easier experience. Selecting shipping names is somewhat of an acquired skill.

Rule Number 2: Select the Most Appropriate and Specific Name from the Table. It's important that the shipping name that is selected accurately describe the material, and also be as specific as possible. Many hazardous materials are comprised of a sole hazardous material that is identified by its technical name in the Table, for example- "ethanol". If an appropriate technical name is not shown in the Table, selection of a proper shipping name must be made from the generic or n.o.s. descriptions corresponding to the specific hazard class, packing group, hazard zone, or subsidiary hazard, if any, for the material.

The name that most appropriately describes the material must be used; e.g., an alcohol not listed by its technical name in the Table must be described as "Alcohol, n.o.s." rather than "Flammable liquid, n.o.s.".

Some mixtures may be more appropriately described according to their application, such as "Coating solution" or "Extracts, flavoring, liquid", rather than by an n.o.s. entry, such as "Flammable liquid, n.o.s." It should be noted, however, that an n.o.s. description as a proper shipping name may not provide sufficient information for shipping papers and package markings. The technical name of one or more

constituents which makes the product a hazardous material may be required in association with the proper shipping name.

Rule Number 3: Follow All the Other Rules!. For reference, there are actually 16 sub-paragraphs describing rules for choosing and using shipping names 172-101(c)(1)-(16). It is important that the offeror review all these provisions. Some of the hi-lights include:

- Shipping names cannot be abbreviated, altered or misspelled, but must appear as they do in the Table in roman lettering (not italics)
- The word, "solution" (liquids), or "mixture" (solids and gases) is added to the end of a technical name when that material is mixed with a non-hazardous material
- They can be singular or plural
- The word "waste" must be added to the beginning of a material that is an EPA-regulated hazardous waste.
- Capitalization does not matter.

Use of the Hazardous Materials Table

49 CFR 172.101(a)-(b), (d)-(l)

The Hazardous Materials Table (49 CFR §172.101) provides much of the information needed to properly prepare a hazardous material for shipment. It either provides that information directly or by referencing other sections of the regulations. Understanding how to use this table is essential.

The Hazardous Materials Table is divided into 10 columns. Individuals concerned only with highway transportation will find the required information in columns 1-8.

Symbols	Hazardous materials descriptions and proper shipping names	Hazard class or Division	Identification Numbers	PG	Label Codes	Special provisions (§172.102)	Packaging (§173.***)			Quantity limitations (see §§173.27 and 175.75)		Location	Other
							Exceptions	Non-bulk	Bulk	Passenger aircraft/rail	Cargo aircraft only		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8A)	(8B)	(8C)	(9A)	(9B)	(10A)	(10B)
	Accellerene, see p-Nitrosodimethylaniline												
	Accumulators, electric, see Batteries, wet *etc*												
	Accumulators, pressurized, pneumatic or hydraulic (containing non-flamable gas), see Articles pressurized, pneumatic *or* hydraulic (containing non-flamable gas)												
	Acetal	3	UN1088	II	3	IB2, T4, TP1	150	202	242	5 L	60 L	E	
	Acetaldehyde	3	UN1089	I	3	A3, B16, T11, TP2, TP7	None	201	243	Forbidden	30 L	E	
A	Acetaldehyde ammonia	9	UN1841	III	9	IB8, IP3, IP7, T1, TP33	155	204	240	200 kg	200 kg	A	34
	Acetaldehyde oxime	3	UN2332	III	3	B1, IB3, T4, TP1	150	203	242	60 L	220 L	A	
	Acetic acid, glacial *or* Acetic acid solution, *with more than 80 percent acid, by mass*	8	UN2789	II	8, 3	A3, A6, A7, A10, B2, IB2, T7,	154	202	243	1 L	30 L	A	

The following is an explanation for each column:

Column 1: Symbols- *172.101(b)*

The symbols in column 1 reference a specific applicability or additional requirement related to the use of the shipping name in column 2, as follows:

(+): The plus symbol is column 1 fixes the proper shipping name, hazard class and packing group for that entry without regard to whether the material meets the definition of that class or packing group or meets any other hazard definition.

(A): The letter "A" restricts the application of requirements to materials offered or intended for transportation by aircraft, unless the material is hazardous substance or hazardous waste.

(D): The letter "D" identifies proper shipping names which are appropriate for describing materials for domestic transportation but may be inappropriate for describing materials for international transportation. An alternate proper shipping name may be selected for international transportation.

(I): The letter "I" identifies proper shipping names which are appropriate for describing materials in international transportation. An alternate proper shipping name may be selected for domestic transportation.

(W): The letter "W" restricts the application of requirements to materials offered or intended for transportation by vessel, unless the material is otherwise listed as a hazardous substance or a hazardous waste.

(G): The letter "G" identifies proper shipping names for which one or more technical names of the hazardous material must be entered in parentheses, in association with the basic description (see §172.203(k)).

Column 2: Shipping Name- *172.101(c)*

Column 2 lists all the proper shipping names for materials designated by the DOT as hazardous materials. The criteria by which proper shipping names are selected were discussed earlier in this MODULE- refer to 172.101(c)(1)-(16).

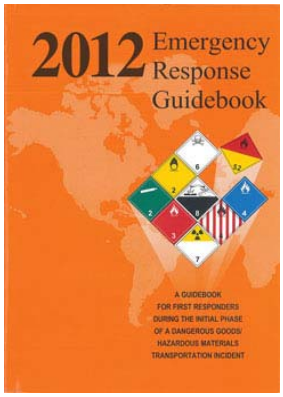
Column 3: Hazard Class or Division- *172.101(d)*

Column 3 contains a numerical representation of the hazard presented by the material (as described in **MODULE 4** of this program). The word "Forbidden" may appear indicating the material may not be offered for transportation. Exemptions may be available for shipping such materials. For materials having more than one hazard, only the primary hazard is shown in column 3.

Column 4: DOT ID Number- *172.101(e)*

Column 4 lists the four-digit identification number preceded by UN, NA, or ID assigned to each proper shipping name. Those preceded by the letters "UN" are associated with proper shipping names considered appropriate for international transportation as well as domestic transportation. Those preceded by the letters "NA"

are associated with proper shipping names only recognized for domestic transportation, including to and from Canada. The prefix “ID” is associated with Consumer commodity- ID8000.



The identification numbers may be used by emergency responders to investigate emergency response protocol for that particular hazardous material as found in the DOT Emergency Response Guidebook (ERG).

The ERG is used by firefighters, spill response teams and other "first responders". It contains basic physical and health hazard information and response protocol, including initial actions to be taken by emergency responders to protect life, the environment, and property, fire-fighting measures, and first aid. The ERG also contains downwind evacuation distances for materials that are poisonous by inhalation.

Column 5: Packing Group- *172.101(f)*

Column 5 specifies the packing group(s) associated with a shipping name. Packing groups I, II and III indicate the degree of danger presented by the material as being great, medium or minor, respectively. Packing groups are used for determining the proper packaging based on the performance rating of the packaging as indicated on the UN-Specification container marking (represented as an X, Y, or Z) as described in

All hazardous materials other than explosives, gases, radioactives and a few miscellaneous materials are assigned packing groups. It is the responsibility of the shipper to assign the appropriate packing group.

Packing group assignment criteria is described in the last module, **MODULE 4**.

Column 6: Labels (Hazard Labels)- *172.101(g)*

Column 6 specifies the label code representing the DOT hazard label(s) required to be affixed to the outside of the packaging. The first entry indicates the primary hazard of the material, additional entries are indicative of subsidiary hazards. A label substitution table is included in §172.101(g) which identifies the name of the hazard label associated with each label code referenced in column 6. DOT Chart 13, a guidance document available from DOT (which you can download from your screen) provides color illustrations of the currently acceptable hazard labels.

MODULE 8 is dedicated to labeling and describes the use of hazard labels, including specifications, and rules related to applicability and placement.

Column 7: Special Provisions- *172.101(h)*

When column 7 refers to a special provision, the meaning and requirements for that provision are described in the indicated paragraph code of 49 CFR 172.102. Special provisions are typically a short description of an additional requirement for a particular material or shipping situation. The majority of special provisions apply to air shipments and to shipments in bulk packagings. The letter prefix of a special provision code indicates the category of provision (e.g., A = special provisions applicable to air transport). The offeror should research all special provisions referenced under column 7 for their specific shipping name. If a special provision is applicable to the shipment, it must be followed.

Column 8: Exceptions & Packaging Authorizations- *172.101(i)*

Columns 8A, 8B, and 8C reference particular sections of 49 CFR Part 173 which prescribe specific exceptions and packaging requirements. Column **8A** contains either the section number of Part 173 that describes applicable exceptions to the packaging requirements, or the word "*none"* indicating that no exceptions are authorized. Column **8B and 8C** references the sections of Part 173 that prescribe specific packaging requirements or lists of authorized packagings for non-bulk and bulk packagings, respectively. Packaging authorizations and exceptions are described in detail in **MODULE 6**.

Column 9: Quantity Limitations- *172.101(j)*

Columns 9A and 9B specify the maximum quantities that may be offered for transportation in one package by passenger-carrying aircraft or passenger-carrying rail car (Column 9A) or by cargo aircraft only (Column 9B). The word, "Forbidden" appearing indicates that the material may not be offered for transportation or transported in the applicable mode of transport. The quantity limitation is "net" except where otherwise specified. When articles or devices are specifically listed by name, the net quantity limitation applies to the entire article or device (less packaging and packaging materials) rather than only to its hazardous components.

*It is important to note that in many cases, an individual air carrier is more restrictive than the limits specified in column 9. Additionally, many commercial cargo and passenger airlines follow the IATA Dangerous Goods Regulations (see **MODULE 2** for discussion on this topic), which has limits for passenger and cargo air which are different than what we see under column 9.*

Column 10: Vessel Stowage- *172.101(k)*

Column 10A specifies the authorized stowage locations on board cargo and passenger vessels (ships). Column 10B [Other provisions] specifies codes for stowage requirements for specific hazardous materials. The meaning of each code in Column 10B is set forth in §176.84 of this subchapter. Section 176.63 of this subchapter sets forth the physical requirements for each of the authorized locations listed in Column 10A. The authorized stowage locations specified in Column 10A are defined in 172.101(k)(1).

MODULE 5- Review Questions

1. The proper shipping name for 100% ethanol (ethyl alcohol) is-
    a) Ethanol
    b) Alcohol, n.o.s.
    c) Flammable liquid, n.o.s. (ethanol)
    d) Any of the above
    e) Either a or b

2. The number listed under column 3 of the hazardous materials table (HMT) indicates-
    a) For a multiple hazard material, only the primary hazard
    b) The Hazard Class or Division number
    c) Both primary and subsidiary risk
    d) All of the above
    e) Both a and b

3. The identification number listed under column 4 of the HMT-
    a) Includes a two letter prefix
    b) May be used by responders to look up crucial emergency information
    c) Is assigned to the corresponding shipping name in column 2
    d) All of the above

4. Special provisions are-
    a) Optional
    b) Described in 172.102
    c) Referenced under column 8A of the HMT
    d) All of the above
    e) Both a and b

5. Exceptions are-
    a) Optional
    b) Described in the referenced section of Part 172
    c) Referenced under column 8A of the HMT
    d) All of the above
    e) Both a and c

6. Non-bulk packaging authorizations-
    a) Are referenced under column 8B of the HMT
    b) Are referenced under column 8C of the HMT
    c) Describe packaging options and/or specific packaging requirements
    d) Both a and c

7. Column 9 of the HMT-
    a) Lists passenger air and rail quantity limitations
    b) Lists cargo air quantity limitations
    c) Lists limitations in net quantity, unless otherwise noted
    d) All of the above
    e) Both a and b

MODULE 6: Packaging and Exceptions

Once a hazardous material is properly classified and named, the material must be packaged properly before being offered for transport.

The offeror is responsible for selecting the appropriate packaging and making sure that the packaging chosen meets the general survivability requirements, conforms to the applicable packaging authorizations, and meets the specifications prescribed for the particular material being offered.

Additionally, packaging issues may also be addressed within particular exceptions, special provisions, and/or special permits.

Packaging Terminology & Definitions

49 CFR 171.8

As a hazmat employee involved in packaging, we need to be familiar with the various terms related to packaging used throughout the regulations. The following are some significant definitions:

Packaging- means a receptacle and any other components or materials necessary for the receptacle to perform its containment function.

Package- means a packaging plus its contents.

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; or (3) A water capacity of 454 kg (1000 pounds) or less as a receptacle for a gas. Examples include: drums, barrels, boxes, cylinders, bags, and jerricans.

Bulk packaging- means a packaging which exceed the non-packaging limits. Examples include: portable tanks, cargo tanks, freight containers, rail cars, tank cars, and intermediate bulk packagings (IBCs).

Combination packaging- means a combination of packaging, consisting of one or more inner packagings secured in a non-bulk outer packaging.

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

Overpack- means an enclosure that is used to provide protection or convenience in handling of a package or to consolidate two or more packages. Examples of overpacks are one or more packages: (1) Placed or stacked onto a load board such as a pallet and secured by

strapping, shrink wrapping, stretch wrapping, or other suitable means; or (2) Placed in a protective outer unit such as a box or crate.

Forbidden Materials & Packages

49 CFR 173.21

This Section describes numerous scenarios under which a material may not be offered for transport, such as:

- those specifically listed in HMT column 3 as “forbidden”,
- incompatibles packed together,
- those with too high a magnetic field for aircraft,
- certain explosives,
- a temperature controlled material above its control temperature, and
- materials that could detonate.

Shipper’s Responsibility

49 CFR 173.22

A person who offers hazardous materials in a packaging must: use only authorized packagings; ensure they are tested and marked appropriately; ensure that the manufacturer’s assembly and closure instructions are followed; if applicable, ensure that they are authorized to use a special permit or exemption; and comply with the specific notification and other requirements for fissile, Type B and highway route-controlled quantity radioactives in accordance with 173.22(c).

General Packaging Requirements

49 CFR 173.24-24a

An offeror of a hazardous material package must ensure it is prepared in such a way so that under normal conditions of transport, the packaging survives without breakage, leakage, or is otherwise compromised. Specifically, the offeror must ensure that-

- No hazardous material is released outside of the package;
- The effectiveness of the package is not substantially reduced by internal or external factors;
- There is no hazardous residue adhered to the outside of the package;
- Packaging components in contact with the hazardous material are compatible with the material so as to not, for example, corrode, permeate, soften, or embrittle the component;
- Closures remain leakproof- taking into account the effects of temperature, pressure, and vibration that could be encountered;
- Venting to reduce internal pressure is only permitted when specifically allowed, such with dry ice and cryogenic gas containers; and
- Sufficient outage (ullage) is allowed to ensure no leakage or permanent distortion due to expansion occurs from changes in temperature.

Authorized Packagings and Overpacks

49 CFR 173.25

An overpack, as defined in 49 CFR 171.8, is an enclosure that it used by a shipper to provide protection or convenience in handling of a package or to consolidate two or more packages. Examples would include:

- One or more packages placed or stacked on a pallet and secured by strapping, stretch wrap, or other means.
- One or more packages placed in a protective outer packaging, such as a box or a crate.

Note: Transport vehicles, freight containers, and aircraft unit load devices are not overpacks.

49 CFR 173.25 details the proper use or overpacks, including requirements for the duplication of specific markings and labels onto the outside of the overpack, and restrictions and specific packing requirements for certain materials.

When specification packagings are required, and the specification markings on the inner packages are not visible through the overpack, then the word, "**OVERPACK**" must be marked on the outside.

Note: Beginning January 1, 2012, the overpack requirements also apply to consumer commodities marked ORM-D and ORM-D Air and packagings prepared according to the Excepted Quantity provision of 173.4a (see 49 CFR 173.25(a)(6) for details).

Additionally, paragraph c) this section details the special requirements related to the transportation of overpacked poisons in the same motor vehicle as foodstuffs.

General Packaging Requirements for Air

49 CFR 173.27

In addition to the aforementioned requirements, those offering hazardous materials packages for air transport must:

- Follow the quantity limitations in column 9 of the hazardous materials table;
- Ensure that packagings designed to prevent leakage withstand internal pressures- various methods of determination are described in 173.27(c);
- Ensure that friction type closures use a positive means to prevent loosening (e.g., wired in place), and that screw type closures are secured to prevent loosening (e.g. taped);
- Ensure absorbent materials are included as required based upon hazard and packing group in accordance with 173.27(e); and
- Ensure that the maximum net capacities of each inner packaging do not exceed those described in 173.27(f)*.

**Note: Effective January 1, 2012, 173.27(f) is revised, and corresponding Table 3 added, to address the specific quantity limitations per inner packaging and other packaging requirements applicable to limited quantity packages to be transported by air.*

Requirements for Specific Packagings

49 CFR 173.31-40

There are packaging use procedures and requirements for specific bulk packaging types and for toxic gas cylinders in the following sections: Tanks cars- 173.10 and 173.31; Portable tanks- 173.32; Cargo tanks- 173.33; Intermediate bulk packagings- 173.35; and Toxics in cylinders- 173.40.

Requirements for Radioactive Packagings

49 CFR 173.403

Packaging shipments of radioactive materials must be done in accordance with the provisions of 173.403.

Packaging Authorizations- HMT: Columns 8B & 8C

49 CFR Part 173 as ref. from 49 CFR 172.101 Table

Let's now return to the hazardous materials table we reviewed in MODULE 5 and look at packaging authorizations. For any given material, there will be a section referenced in Part 173 where you will be sent to read the non-bulk and bulk packaging authorizations. These can be very prescriptive or merely a list of packagings to choose from.

Examples

The best way to understand authorizations, is to use examples and look them up, so let's look at examples of both non-bulk and bulk authorizations for "Acetone" and "Biological substance, category B".

Acetone- Non-Bulk Authorization

Go the hazardous materials table and read across from acetone and find under column 8B- 202, that is, 173.202. In 173.202, you'll notice the section title references a group of like materials- "Non-bulk packagings for liquid hazardous materials in Packing Group II". The first paragraph reminds us to follow the general requirements we just discussed, tells us not to use this section unless we've been sent here from column 8B, and that only packagings prescribed in the section can be used.

The next two paragraphs list all the authorized packagings- first combination, then single packagings. Just because a packaging is authorized, doesn't mean it will meet the general survivability we just discussed. The shipper would be wise to act questions, such as, "Could the acetone dissolve the closure gaskets?", and " Would a fiberboard drum with a liner be the best choice in terms of survivability?".

Biological substance, Category B- Non-Bulk Authorization

Let's look at our other example- "Biological substance, category B". Under column 8B, we are sent to 173.199, which is quite different from our previous example- this section is quite prescriptive. It requires the use of a triple combination packaging, the ability to survive a drop test, specific markings, including a telephone number of a person knowledgeable of the contents, describes which materials may be packed in the same package, requirements for absorbents, and so on.

Acetone- Bulk Authorization
For acetone, we are sent to 173.242- Here we see specification numbers on rail tank cars, cargo tanks, and portable tanks. Some of the authorizations describe tank specifications and devices like pressure relief systems and bottom outlets. The section also lists which Intermediate bulk packagings are authorized.

Biological substance, Category B- Non-Bulk Authorization
For biological substances, category B, under column 8C we see there are no bulk packagings authorized.

Exceptions- HMT: Column 8A

49 CFR Part 173 as ref. from 49 CFR 172.101 Table

Exceptions are intended to relax some or all of the requirements of the regulations if certain conditions are met. They can be very unique to the specific shipping name, or they may be more general exceptions used by groups of materials. Like packaging authorizations, they are found in a section of Part 173 referenced under column 8 for a particular shipping name.

The most common exceptions you will see referenced are the "Limited Quanties" and "Consumer Commodities" exceptions, but there may be many others specific to the material being offered.

The Limited Quantity Exception

A limited quantity exception typically allows the use of a non-specification, non-bulk packaging and excepts the offeror from the placarding requirements, and in some cases, also the labeling requirements. The exception prescribes combination packaging configurations and limits the quantities of both the inner packagings and the gross weight of the completed package.

The Consumer Commodity Exception

Consumer commodities are those hazardous materials that are packaged and distributed in a form suitable or intended for sale through retail sales agencies for consumption by individuals for personal or household use. Common examples include retail products that meet the consumer packaging requirements, such as spray paints, lighter fluid, PVC pipe cement, hairspray, drain cleaner, charcoal briquettes, and prescription medicines. Consumer commodities must meet the limited quantity provision first and are then are also excepted from shipping papers.

Note: Consumer commodity exceptions are revised effective January 1, 2012. Changes include the removal of the ORM-D designation and marking as of January 1, 2014 (January 1, 2013 for ORM-D Air), the use of the shipping description: ID8000, Consumer Commodity, 9, and the inclusion of the shipping paper requirements

Exceptions not referenced in the HMT

49 CFR 173.4, 173.6, 173.12-14, 173.421-426

There are also exceptions that are not referenced under column 8A of the hazardous materials table- they include those for small quantities, materials of trade, certain radioactives, certain hazardous wastes, and for materials in specific packaging configurations.

Small Quantity Exception- 173.4

This exception allows small quantities of certain materials packaged in a very specific manner to be excepted from all other provisions of the regulations. An excepted quantity can summarized as –

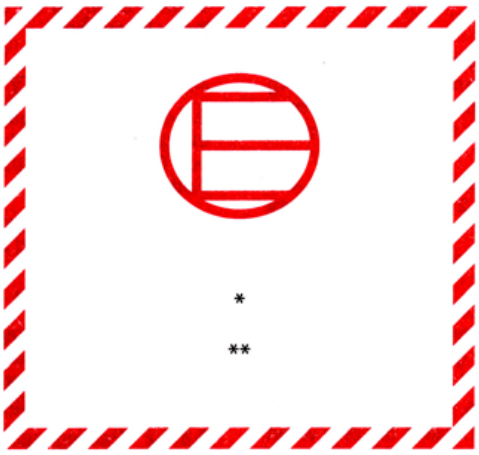
- Inner packagings being limited to specific weight and volumes as dictated by the Class and Packing Group (1 ounce or 0.04 ounces in some cases),
- the completed package cannot exceed 64 lbs.,
- being able to survive a five orientation drop test and a compressive load test, the the the manner of packaging being very prescriptive, and
- requiring the following text be marked on the outside of the package (some very small quantities do not require this statement- 173.4(e)):

THIS PACKAGE CONFORMS
TO 49 CFR 173.4
FOR DOMESTIC HIGHWAY
OR RAIL TRANSPORT ONLY

Excepted Quantities for Air & Water- 173.4a

This exception allows small quantities of certain materials offered for air and packaged in a very specific manner to be excepted from all other provisions of the regulations. An excepted quantity can be summarized as –

- Inner packagings are limited to specific weight and volumes as dictated by the Class and Packing Group (1 ounce or 0.04 ounces in some cases),
- the total aggregate quantity per package is dictated by Class and Packing Group, and the manner of packaging is very prescriptive,
- the completed package cannot exceed 64 lbs.,
- the package must survive a five orientation drop test and a compressive load test, and those tests must be documented,
- for air, no documentation is required, however if an air waybill is used, then the words, “Dangerous Goods in Excepted Quantities” must be entered,
- for water, documentation is required and the words, “Dangerous Goods in Excepted Quantities” must be entered
- the package must be marked with the following marking in either black or red on a contrasting background and be of a minimum dimension of 100 mm x 100 mm (3.9 inches):



* *Insert class/division number in this location*
** *Insert the name of the shipper or of the consignee in this location (if not shown elsewhere on the package)*

De Minimus Exception- 173.4b

This exception allows very small quantities of certain materials offered for air and packaged in a very specific manner to be excepted from all other provisions of the regulations. A de minimus exception package can be summarized as –

- Inner packagings are limited to specific weight and volumes as dictated by the Class and Packing Group (not exceeding 1 milliliter for liquids, 1 gram for solids), and the manner of packaging is very prescriptive,
- The total aggregate quantity per package must not exceed 100 ml. or 100g.
- the completed package cannot exceed 64 lbs.,
- the package must be capable of surviving a five orientation drop test and a compressive load test, and

Note: Beginning January 1, 2012, non-infectious scientific research specimens, such as specimens of mammals, birds, amphibians, fish, insects, and other invertebrates, containing small quantities of Ethanol (UN1170), Formaldehyde solution, flammable (UN1198), Alcohols, n.o.s. (UN1987), and Isopropanol (UN1219) may be prepared in accordance with the De Minimus Exception.

Excepted Quantities of Radioactives

There is a similar exception for certain small quantities Class 7 materials found in 173.421, 422, 424, and 426.

Materials of Trade- 173.6

Materials of trade (MOTs) are hazardous materials, other than hazardous wastes, that are in a vehicle for another reason other than typical commerce, either to: 1) protect the driver or passengers; 2) support the operation or maintenance of the vehicle; or 3) carried by a private carrier to support the principle business.

MOTs are excepted from all other provisions of the regulations and the exception contains provisions related to-

- Per packaging and per vehicle quantity limitations
- DOT or equivalent packaging
- Marking of the contents and related hazards
- Securing of the MOTs in the vehicle; and
- Training for the driver

Exceptions from Hazard Labeling, Placarding and Segregation- 173.13

A Class 3, 8 or 9, or Division 4.1, 4.2, 4.3, 5.1, or 6.1 material is excepted from the labeling (except for the CARGO AIRCRAFT ONLY label), placarding and segregation requirements if prepared for transport in accordance with the requirements of 173.13. A material that meets the definition of a material poisonous by inhalation may not be offered for transportation or transported under provisions of this section.

Exceptions for hazardous waste shipments-173.12

Section 173.12 contain specific exception for certain hazardous waste shipments, including-

- Open head drums used when closed head drums are normally required
- Lab packs
- Reuse without complying with the requirements of 173.28 (see next section)
- Technical names not being required for under the lab pack exception
- Exceptions from the segregation requirements for marine, highway and rail shipments

Reuse, Reconditioning & Remanufacturing

49 CFR 173.28

Reuse-173.28(b)

If a hazardous material packaging is to be reused, all the components must be compliant, inspected by the reuser, free of residue, disinfected (in the case of infectious substances), undamaged, and show no loss of integrity. Packagings made of paper (other than fiberboard), plastic film or textiles are not eligible for reuse. Additionally, Metal and plastic drums and jerricans used as single packagings must meet the minimum thickness requirements to be eligible for reuse (173.28(b)(4)).

Leakproofness Testing for Packagings to be Reused- 173.28(b)

Containers that were originally required to be leakproof tested using air pressure in accordance with 178.604, must be leakproof tested again in accordance with the test method described in 173.28(b)(2) and marked “L”, followed by the name and address or symbol of the retester, and the year of retesting, e.g.,”09”.

Special Provision for Hazardous Waste
Under 173.12(c), reuse of such a packaging for a hazardous waste shipment is exempt from the aforementioned retesting provision, provided the waste is to be shipped by highway, filled for at least 24 hours prior to being shipped, visually inspected prior to loading, loaded by shipper and unloaded by the consignee, unless transported by a private or contract carrier, and reused only once.

Special Provision for Packaging Constructed of Certain Materials
Under 173.28(b)(7), packagings constructed of stainless steel, monel, nickel, and plastic are exempt from retesting under certain conditions.

Reconditioning- 173.28(c)

This section describes the reconditioning process of non-bulk packagings and the required marking identifying the packaging as reconditioned in accordance with 178.503(c), e.g., "USA/Reconditioner/09/RL".

Empty Packagings- 173.29

This section addresses packagings that once contained hazardous material but were emptied of their contents. Generally, residues are regulated to the same extent as a full package of hazardous material. If a packaging is cleaned of residue and purged of vapor to remove any potential hazard, it is considered no longer regulated.

There are however, exceptions for certain residue-containing packagings detailed in 173.29.

Additional Packaging Provisions

The early sections of Part 173 also contain packaging provisions related to specific situations, as follows-

- The use of salvage drums and cylinders- 173.3
- Agricultural operations- 173.5
- Oilfield service vehicles and equipment- 173.5a
- Government operations and materials- 173.7
- Intrastate transport of non-specification packages- 173.8

MODULE 6- Review Questions

1. A non-bulk packaging for liquids is defined as having a maximum capacity of-
    a) 882 gallons
    b) 1,000 pounds of water
    c) 119 gallons
    d) None of the above

2. The offeror must ensure that during transport-
    a) The effectiveness of the packaging is not substantially reduced
    b) No hazardous material is released from a package
    c) Closures remain leakproof
    d) All of the above
    e) Both b and c

3. The general packaging requirements for air shipments include provisions for-
    a) Absorbents
    b) Preventing closures of inner packagings from loosening
    c) Quantity limitations for inner packagings
    d) All of the above
    e) Both a and b

4. Exceptions are-
    a) Also known as “exemptions” and “special permits”
    b) Are available for every hazardous material
    c) Referenced under column 8A of the HMT
    d) All of the above
    e) Both a and b

5. A consumer commodity-
    a) Is an example of an exception
    b) Does not include medications
    c) Is not a hazardous material
    d) All of the above
    e) Both a and c

6. Reuse requirements include-
    a) A special provision for reusing packagings for hazardous waste
    b) Re-testing certain packagings for leakproofness
    c) Drop testing
    d) All of the above
    e) Both a and b

7. A packaging that contains a hazardous residue is always-
    a) Considered no longer regulated as a hazardous material
    b) Shipped as a Class 9- miscellaneous material
    c) Excepted from the reuse requirements
    d) Both a and b
    e) None of the above

MODULE 7: Packaging Specifications

The DOT has specifications for both bulk and non-bulk packagings. To be authorized for use with hazardous materials, packagings need to meet certain design specifications and/or pass certain testing standards.

Those specifications are found in Part 178 and 179. . . .all 345 pages of them! If we include the requirements for continuing qualification and maintenance of packaging in Part 180, that brings us up to approximately 400 pages of regulation dealing with the design, manufacture, qualification, testing, and maintenance of packagings used to contain hazardous materials during transport.

Shipper's Responsibility for Spec. Packagings

49 CFR 173.22(a)(2)

The offeror is responsible for selecting the appropriate packaging and making sure that the packaging chosen meets the prescribed specifications. Additionally, packaging specifications issues may be addressed within particular exceptions, special provisions, and/or special permits.

Packaging Authorizations discussed in **MODULE 6** often reference packagings having specifications. This is done by referring to a specification code, for example: 1A1 or 1A2 steel drums; 4G fiberboard boxes; DOT 3AA steel cylinders; 13H3 intermediate bulk packagings, and DOT 407 cargo tanks. The shipper is responsible for ensuring that the packaging does in fact meet the referenced standard.

With most bulk packagings in addition to most gas cylinders, that's easy- if a DOT 407 cargo tank is authorized, we ensure that "DOT 407" is marked on the dataplate on the tank. If a DOT-3AA cylinder is authorized, we find the stamp on the cylinder that reads "DOT 3AA".

When it comes to most non-bulk packagings and IBCs, however, it's a little more complicated- these two categories must meet what's known as UN-Specification Packaging Standards, also known as Performance-Oriented Packaging Standards, which is an international system based upon United Nations Recommendations. Shippers must understand how to interpret the UN-Specification test markings because they contain criteria which must be met, such as those related to the packing group, weight, specific gravity, and vapor pressure of the hazardous material allowed to be contained within the packaging.

UN-Specification Packagings- Testing & Marking

Non-Bulk: 49 CFR 178.500-523; IBCs: 178.700-710

The UN-Specification packaging standard of testing is required for all non-bulk (except most gas cylinders) packagings and for Intermediate Bulk Packagings (IBCs).

A manufacturer must mark each packaging that meets the UN standard. The marking indicates that the container has been tested and met certain performance standards. The testing that is required to meet UN specifications may include leakproofness, dropping, stacking, hydrostatic pressure and vibration. The shipper must ensure that the test marking is appropriate for the material to be contained with respect to weight, specific gravity, packing group, and packing group, as applicable. The marking must be visible during transport.

The UN marking is made up of eight or nine separate sections, depending upon whether the packaging is eligible for reuse. Sections 178.502-503 describe a non-bulk packaging test marking as follows:

Non-Bulk UN-Specifcation Test Marking

1) The **symbol**: may appear as shown or just the letter "UN" preceding the marking.

2) The **type, material and category** of container as the two or three digit Packaging Identification Code, as follows:

Type (1st Character)	Material (2nd Character)
1 Drum	A Steel
2 Wooden Barrel	B Aluminum
3 Jerrican	C Natural Wood
4 Box	D Plywood
5 Bag	F Reconstituted
6 Composite Packaging	G Fiberboard
7 Pressure Receptacle	H Plastic
	L Textile
	M Multi-wall Paper
	N other Metal
	P Glass, Porcelain or Stoneware

Category (3rd Character)

For A, B, C, and H Drums, Barrels and Jerricans:	For A and B Boxes:
1 Closed Head	1 Ordinary
2 Open Head	2 With liner or inner coating
For L Bags:	**For C Boxes:**
2 Sift proof	1 Ordinary
3 Water resistant	2 With sift proof walls
For M Bags:	**For H Boxes:**
2 Water resistant, multi-wall	1 Expanded plastic
	2 Solid plastic

"V" Indicates alternative testing method in 178.601(g)(2).

3) The letter **"X", "Y", or "Z"** denoting the performance standard that has been met resulting from various performance tests. Each letter meets a different packing group standard: X for Packing Group I, II, and III; Y for Packing Group II and III; Z for Packaging Group III.

4) The maximum **gross mass or specific gravity** that the packaging has been successfully tested for. Gross mass would be given in kilograms for solids, viscous liquids or inner packagings. Specific gravity for non-viscous liquids would be given with a value relative to water being equal to 1.0.

   Note: For packagings designed and tested for infectious substances in accordance with 178.609, items 3) and 4) above are replaced with the marking, "Class 6.2".

5) The **hydrostatic pressure** for which the packaging has been successfully tested will be given in kilopascals (kPa) for liquids or if the packaging is meant only for use with solids or inner packagings, then the letter **"S"** will appear.

   To calculate if the vapor pressure of a liquid is too high for the packaging's pressure rating, one of the following two formulas may be used:
   V.P. at 50 C (112 F) < 4/7 (marked test pressure + 100 kPa), or
   V.P. at 55 C (131 F) < 2/3 (marked test pressure + 100 kPa)
   (Ref: 173.24a(b)(4))

6) Two digits indicating the **year of manufacturer**.

7) The symbol for the **country** under whose authority the packaging was tested and the UN marking applied . (International Motor Vehicle Symbols are used).

8) The name or symbol of the **manufacturer** (very often a model number will be included as well).

9) The **minimum thickness** of the packaging (those containers intended for reuse).

An **example** of a typical non-bulk UN Marking:

(UN) 1A1/Y1.5/160/09/USA/M4072/1.1mm

1A1	Steel drum with closed head
Y	For Packing Groups II and III
1.5	For liquids up to specific gravity of 1.5
160	Passed hydrostatic test pressure of 160 kPa
09	Manufactured in 2009
USA	Manufactured and marked in the United States
M4072	Symbol of manufacturer
1.1mm	Minimum thickness = 1.1 millimeters

Sections 178.702-703 describe an intermediate bulk packaging test marking as follows:

UN-Specifcation Test Marking for IBCs

1) The ⓤn **symbol**: may appear as shown or just the letter "UN" preceding the marking.

2) The **type, material and category** of container as the two or three digit Packaging Identification Code, as follows:

Type (1st Character)	Material (2nd Character)
11 Rigid for solids discharged by gravity	A Steel
13 Flexible for solids discharged by gravity	B Aluminum
21 Rigid for solids discharged under pressure	C Natural Wood
31 Rigid for liquids	D Plywood
	F Reconstituted Wood
	G Fiberboard
	H Plastic
	L Textile
	M Multi-wall Paper
	N other Metal

Additional Designations (3rd Character)

For Rigid Plastic IBCs:	For Flexible IBCs:
1 Fitted with structural equipment designed to withstand stacking load	1 Without coating or liner
2 Freestanding	2 Coated
	3 With Liner
	4 Coated with Liner
	5 Plastic Film (13H5 only)

For Composite IBCs:
1 Rigid Plastic Inner Receptacle
2 Flexible Plastic Inner Receptacle

3) The letter **"X", "Y", or "Z"** denoting the performance standard that has been met resulting from various performance tests. Each letter meets a different packing group standard: X for Packing Group I, II, and III; Y for Packing Group II and III; Z for Packaging Group III.

4) The **month** (first two digits) and **year** (last two digits) of manufacture.

5) The symbol for the **country** under whose authority the packaging was tested and the UN marking applied. (International Motor Vehicles Symbols are used).

6) The name or symbol of the **manufacturer** (very often a model number will be included as well).

7) The **stacking test load** in kilograms. For IBC's not designated for stacking, the figure "O" is shown.

8) The maximum permissible **gross mass** or for flexible IBCs, the maximum **net mass** in kilograms (kg).

An **example** of a typical IBC UN Marking:

	(un) 31H1/Y/11 09/USA/M9399/10800/1200
31H1	A rigid plastic IBC containing liquids, designed with structural equipment to withstand the whole stacking load
Y	For Packing Groups II and III
11 09	Manufactured in November, 2009
USA	Manufactured and marked in the United States
M9399	Symbol of the manufacturer
10800	Tested for a stacking load of 10,800 kilograms
1200	maximum permissible net mass of 1,200 kg. (gross for flexible)

Re-Qualification & Maintenance

49 CFR Part 180

Part 180 effects shippers who own or lease hazardous materials packagings designed for reuse, such as IBCs and portable tanks. For example- the schedule for inspecting and re-testing of IBCs is found in 180.352, shippers who own or lease, and refill such packagings would be responsible for ensuring that periodic testing and inspection is performed in accordance with that section.

MODULE 7- Review Questions

1. A packaging marked- Ⓤ1A1/Y1.5/160/09/USA/M4072/1.1mm -
    a) Has been tested up to 160 kPa internal pressure
    b) Is approved for a net mass of up to 160 kilograms
    c) Has been tested for a stacking load of 160 kilograms
    d) None of the above

2. A packaging marked- Ⓤ1A1/Y1.4/135/09/CAN/CD6788/1.0mm -
    a) Can handle solids having a net mass of up to 135 kilograms
    b) Can handle liquids up to a specific gravity of 1.4
    c) Has been tested for Packing Group I and II materials
    d) All of the above
    e) Both b and c

3. A packaging marked- Ⓤ1A2/Y200/S/08/USA/VL8220-
    a) Has been leakproof tested
    b) Is eligible for reuse
    c) Can handle solids up to a gross mass of 200 kilograms
    d) Both a and b

4. A packaging marked- Ⓤ1A1/Y1.5/160/09/USA/M4072/1.1mm can handle the internal pressure created by a liquid having a vapor pressure (at 55°C) of-
    a) 165 kPa
    b) 171 kPa
    c) 175 kPa
    d) All of the above
    e) Both a and b

5. A packaging marked- Ⓤ4G/Y11/S/09/USA/+AD77123-
    a) Is a plastic box
    b) Is a fiberboard box
    c) Is designed for Packing Group II and III materials
    d) Both b and c

6. A packaging marked- Ⓤ31H1/Y/1 09/USA/M9992/0/1100
    a) Is not stackable
    b) Is plastic and rigid
    c) Can hold up to 1,100 kilograms of material
    d) All of the above
    e) Both b and c

7. A packaging marked- Ⓤ3H2/X8.5/S/09/USA/+AC7612-
    a) Is approved for solids or inner packagings, but not free liquid
    b) Is an open head plastic jerrican
    c) Must not exceed 8.5 pounds gross mass
    d) All of the above
    e) Both a and b

MODULE 8: Labeling

Now that we have our hazardous material packaged, we need to communicate the hazards to handlers, transporters, receivers, and most importantly, emergency responders.

The principle means of communicating the hazard, or hazards, of a material on the outside of a non-bulk packaging and some smaller bulk packagings- is with the use of square-on-point (diamond-shaped) 4" labels that incorporate colors, patterns, symbols, numbers, and text. The idea is that these can be easily identified by a trained eye so that responders and others can quickly recognize the hazards, even from a distance. These decals are known as hazard labels.

There are four aspects to hazard labeling we need to understand:

1) How we know which label to affix to our packaging;
2) Where to find a reference to what the label should look like;
3) Where to find the rules related to proper display of labels; and
4) Where to find special rules for radioactives

Which Label(s) to Use

49 CFR 172.400(b)

In **MODULE 5** we learned how to read and use the hazardous materials table. Once we have established which row we need to follow, simply look to column 6 and read the "label code" which is a reference to the Class or Division #, and in the case of explosives, also incorporates the compatibility group letter, for example- "1.4D". If a material has more than one hazard, then the second label code listed under column 6 represents the subsidiary hazard.

There are two specific cases when the label code alone is not enough information to select the proper label, the first is with toxics- Div. 6.1. In addition to label code "6.1", we need to know if the material meets the definition of a "Material poisonous by inhalation" as defined in 171.8. The second is in the case of radioactives. With a radioactive, we must also know the radiation level at the surface of the package and if the material meets the definition of "Fissile"; this will determine which of the four radioactive labels must be used, Category I, II, III, or the Fissile label.

The best method for determining which label must be used is by looking at the labeling application table in 172.400(b). This chart references the labels applicable to all hazard classes, divisions, and the aforementioned special situations for toxics and radioactives.

Labeling Applicability Table- 172.400(b)

Hazard class or division	Label name	Label design or section reference
1.1	EXPLOSIVES 1.1	172.411
1.2	EXPLOSIVES 1.2	172.411
1.3	EXPLOSIVES 1.3	172.411
1.4	EXPLOSIVES 1.4	172.411
1.5	EXPLOSIVES 1.5	172.411
1.6	EXPLOSIVES 1.6	172.411
2.1	FLAMMABLE GAS	172.417
2.2	NONFLAMMABLE GAS	172.415
2.3	POISON GAS	172.416
3 (flammable liquid) Combustible liquid	FLAMMABLE LIQUID (none)	172.419
4.1	FLAMMABLE SOLID	172.420
4.2	SPONTANEOUSLY COMBUSTIBLE	172.422
4.3	DANGEROUS WHEN WET	172.423
5.1	OXIDIZER	172.426
5.2	ORGANIC PEROXIDE	172.427
6.1 (material poisonous by inhalation (see §171.8 of this subchapter))	POISON INHALATION HAZARD	172.429
6.1 (other than material poisonous by inhalation)	POISON	172.430
6.1 (inhalation hazard, Zone A or B)	POISON INHALATION HAZARD	172.429
6.1 (other than inhalation hazard, Zone A or B)	POISON	172.430
6.2	INFECTIOUS SUBSTANCE[1]	172.432
7 (see §172.403)	RADIOACTIVE WHITE-I	172.436
7	RADIOACTIVE YELLOW-II	172.438
7	RADIOACTIVE YELLOW-III	172.440
7 (fissile radioactive material; see §172.402)	FISSILE	172.441
7 (empty packages, see §173.428 of this subchapter)	EMPTY	172.450
8	CORROSIVE	172.442
9	CLASS 9	172.446

Label Specifications

49 CFR 172.407-446

The labeling table also references the sections of the regulations that show the label image and describe the specifications of each label.

Section 172.407 describes all those specifications, including design, durability, size, and color. This section also references the images of each hazard label which are shown in Sections 172.411- 446. A summary of the main points are as follows:

- Each label must be at least 3.9” (100 mm) per side.

- They must be durable and weather resistant and able to survive 30 days of transport without deterioration or substantial color change;

- Labels for explosives must incorporate the proper compatibility group letter as shown in the label code under column 6 of the hazardous materials table;

- Color specifications are given by formula number code from the Pantone color formula guide.

To see images of these labels in living color, the DOT has produced a color labeling chart known as "Chart 14". You can download an image of Chart 14 from the DOT website at- http://phmsa.dot.gov/hazmat/training/publications.

General Labeling Requirements

49 CFR 172.400

The following packages and containment devices must be labeled prior to being offered for transport-

1. Non-bulk packages
2. Portable tanks under 1,000 gal. capacity (unless placarded)
3. DOT-106 or DOT-110 multi-unit tank cars (unless placarded)
4. Overpacks, freight containers, or unit load devices under 640 cubic feet (unless placarded)
5. Additionally, some packages are excepted from labeling- these are described in 172.400a.

If a material has more than one hazard, then both the primary and subsidiary hazard labels must be displayed.

Label Placement Requirements

49 CFR 172.406

The following is a summary of the principal rules associated with placement-

- Labels must be clearly visible and may not be obscured by markings or attachments.

- Labels must be printed on or affixed to a surface other than the bottom (tags may be used in some cases as described in 172.406(b)).

- Labels must be located on the same surface and near the proper shipping name marking.

- Primary and subsidiary labels must be displayed next to each other, that is, no more than six inches apart.

- Labels must be displayed on a contrasting background unless they have solid or dotted line outer borders.

- A label does not need to be duplicated except, in the following cases the labels must appear on at least two opposite sides or ends:
    - A Package or overpack exceeding 64 cubic feet in volume
    - A non-bulk package containing a radioactive material
    - A DOT-106 or DOT-110 multi-unit tank car
    - A Portable tank having less than 1,000 gallon capacity
    - Freight containers and unit load devices between 64 and 640 cubic feet
    - IBCs greater than or equal to 64 cubic feet in volume

Special Rules for Radioactive Labels

49 CFR 172.403

Category I (all white) or Category II, or III (yellow and white) radioactive labels are selected based upon the maximum radiation level at any point on the surface in accordance with 172.403(c).

Radioactive labels must appear on at least two opposite sides of a packaging.

The following must be entered on the label in durable, weather resistant, manual or mechanical marking:

- The names of the radionuclides (as taken from 173.435);
- The activity in the package in SI units (e.g., Becquerels, Bq, TBq); customary units may appear in parens after the SI units (e.g., Ci, mCi, uCi);
- Additionally, in the case of Category II and III labels, the transport index*.

**Note: Transport index (TI), as defined in 173.403, means the dimensionless number (rounded up to the next tenth) placed on the label of a package, to designate the degree of control to be exercised by the carrier during transportation. The transport index is determined by multiplying the maximum radiation level in millisieverts (mSv) per hour at 1 m (3.3 ft) from the external surface of the package by 100 (equivalent to the maximum radiation level in millirem per hour at 1 m (3.3 ft)).*

The "EMPTY" label, is used to identify packagings which previously contained radioactive materials and have been emptied to the extent practical.

The criticality safety index (CSI) must be entered on a FISSILE label. See 173.403 for definitions. See 172.402(d) for applicability and use of the FISSILE label.

MODULE 8- Review Questions

1. Hazard labels for explosives-
    a) Are orange
    b) Include a compatibility group letter
    c) Must be affixed to two or more sides of a packaging
    d) All of the above
    e) Both a and b

2. Hazard labels have specifications related to -
    a) Size
    b) Color
    c) Shape
    d) All of the above
    e) Both a and c

3. Hazard labels must be duplicated on at least two opposite sides of-
    a) Packagings of explosives
    b) Portable tanks with greater than 1,000 gallon capacity
    c) Packagings of radioactives
    d) All of the above
    e) Both b and c

4. The Division 2.2 non-flammable gas label incorporates-
    a) The color green
    b) A symbol of a compressed gas cylinder
    c) The number 2.2
    d) All of the above
    e) Both a and b

5. Primary and subsidiary hazard labels must be oriented on a packaging-
    a) No more than 8 inches apart
    b) With the primary located above the subsidiary
    c) With the primary located to the left of the subsidiary
    d) Both b and c
    e) None of the above

6. Radioactive labels include -
    a) Category I, II, and III hazard labels
    b) Fissile hazard label
    c) Empty label
    d) All of the above

7. A Division 6.1 inhalation hazard label is used for-
    a) Gases poisonous by inhalation
    b) Asphyxiating gas
    c) Division 6.1, Zone A and B poison inhalation hazard materials
    d) All of the above
    e) Both a and c

MODULE 9: Marking

In the last MODULE we talked about affixing labels as a way to communicate the hazards inside a packaging, in a standardized easily recognizable way, to handlers and emergency response personnel.

Now it's time to put other information on the outside of the packaging that will give more specific information about the hazardous material and the shipment- these are "markings".

Markings come in several forms- either text or graphic information- sometimes referred to as handling labels- we'll talk about each. Although there are a few that are always required, there are many specific markings required only in certain circumstances.

We'll address the requirements for marking in two segments- first for non-bulk packagings, then for bulk- they really are quite different.

Non-Bulk Marking Requirements

49 CFR 172.301, 310-324, 448

The offeror is responsible for properly marking non-bulk packagings prior to transport. Markings must be durable, and affixed to, printed on, or attached to, the package.

Markings need to be clearly visible, sharply contrasting in color, in English, not obscured or overwhelmed by other information on the packaging, and be capable of surviving open weather conditions without degradation to the extent they are no longer legible or no longer meet specifications.

Specific markings and their associated applicability are as follows. Three markings are always required-

1. Every non-bulk package must be marked with the **proper shipping name,** Additionally, if a **technical name** is required in parentheses, then it is also marked along with the shipping name, for example- flammable liquids, n.o.s. (acetone, xylenes);
2. Every non-bulk package must be marked with the **identification number** (with the UN or NA prefix) adjacent to the shipping name; and
3. Every non-bulk package must be marked with the **consignor or consignee's name and address** (there are exceptions).

Additionally, there are other markings that are required in certain circumstances, as follows:

- Each package authorized by a **special permit** (described in **MODULE 4**), must be marked DOT-E or DOT-SP followed by the assigned number of the exemption;

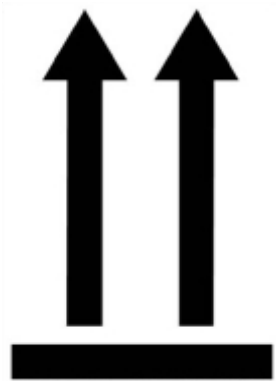
- Each specification cylinder of **LP gas that is not odorized**, must be marked NON-ODORIZED or NOT ODORIZED;

- Some Packagings of **radioactives** must be marked with the gross mass and/or radioactive packaging Type (e.g., "TYPE IP-3") in accordance with 172.310;

- Overpacks must be marked with the word, "**OVERPACK**" as described in 173.25(a)(4) and 173.25(a)(6)- See **MODULE 6**.

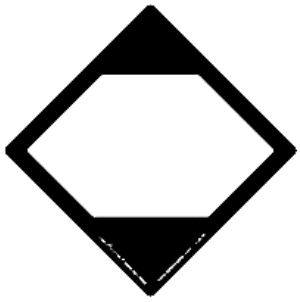
- The following text must be marked on the outside of the package when the small quantity exception of 173.4 is used, "**This Package Conforms to 49 CFR 173.4 for Domestic Highway or Rail Transportation Only**". See **MODULE 6**.

- Each combination packaging containing liquids in the inner packaging(s), vented single packagings, and open cryogenic gas containers must be marked with the **Package Orientation** marking (shown below). There are exceptions to this rule- 172.312(c) list seven cases where this is not required. The arrows may be red or black, the border is optional, the arrows must be on a contrasting background, the marking must appear on two opposite vertical sides, and the size of the marking must be appropriate to package size;



- Materials poisonous by inhalation must be marked **INHALATION HAZARD** if not already labeled or placarded as such;

- **<u>Limited Quantity shipments by Highway, Rail and Water</u>**- The marking below may be used instead of the shipping name and ID # on a limited quantity shipment, other than those offered by air. The minimum dimension required is 100 mm per side, unless dimensions of packaging are too small, then a 50 mm version may be used.



- **<u>Limited Quantity shipments by Air</u>**- The marking below must be used in addition to all other required markings on a limited quantity air shipment meeting the limitations of Table 3 of 173.27(f). The minimum dimension required is 100 mm per side, unless dimensions of packaging are too small, then a 50 mm version may be used

- <u>Consumer commodities</u> must be marked **ORM-D or ORM-D-AIR** following or below the shipping name and in a rectangle which is at least ¼ inch larger than the marking (example below);

Note: Beginning January 1, 2014, the "ORM-D" marking will no longer be used. (The "ORM-D Air" marking will no longer be used, beginning January 1, 2013)

- Self-reactive flammable solids in Division 4.1, and organic peroxides (Division 5.2), when transported by air must be marked with the **KEEP AWAY FROM HEAT** marking (shown below) in accordance with 172.317. The minimum dimension must be 74 x 105 mm;

- Explosives must be marked with the **EX-number** of the explosive, unless excepted, in accordance with 172.320;

- The **Cargo Air Only** image described in 172.448 (actually found in the labeling Subpart of the regulations) is used for all air shipments which are either forbidden from passenger air or are prepared in such a way that they are not acceptable for passenger flights- this could be due the packaging type or configuration, or most often, the quantity exceeds the passenger limits (shown below);

Note: *The earlier design of the Cargo Air Only label (shown at left) may continue to be used until January 1, 2013.*

- Non-bulk packagings containing a marine pollutant transported by vessel or in bulk packagings, must be marked with the **MARINE POLLUTANT** marking (shown below) in accordance with 172.322- the applicability of the marine pollutants rule will be discussed in **MODULE 11**- shipping papers;

- For hazardous substances, the letters "**RQ"** and the name of the **hazardous substance or EPA waste code** in parantheses must be marked with the shipping name. Hazardous substances and RQ values will be discussed in **MODULE 11**- shipping papers.

- The biohazard marking (shown below) is required to be marked on several types of non-bulk packagings described in the infectious substances regulations of 173.134. Additionally, bulk packagings of regulated medical waste must be marked with an orange **biohazard** marking. 172.323 details the specific size and placement requirements.

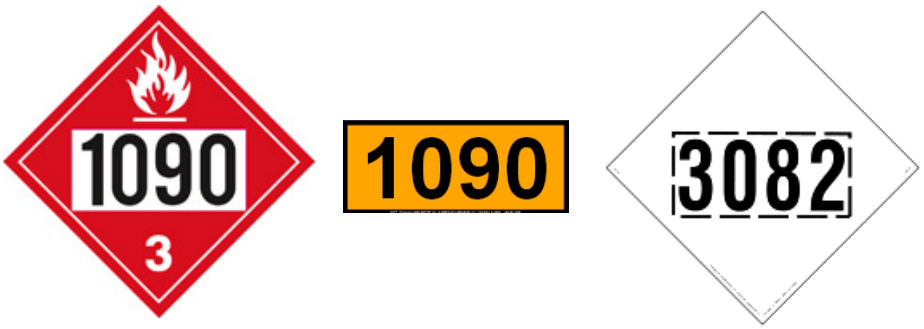
Bulk Marking Requirements

49 CFR 172.302, 326-338, 173.9

Bulk packagings also have markings that must be displayed during transport. The offeror of such a packaging must ensure each applicable marking is affixed and clearly visible when presenting the bulk packaging for transport. Specific markings and their associated applicability are as follows:

- When required by Sections 172.301, 172.302, 172.313, 172.326, 172.328, 172.330, or 172.331, **Identification numbers** (w/out prefix) must be displayed on a bulk packaging. The number must appear on at least 2 opposite sides if the packaging has less than a 1,000 gallon capacity), and all 4 sides if its capacity equals or exceeds 1,000 gallons.

  The number must be configured within a hazard placard (see **MODULE 10** for a description of placarding), an orange panel, or on a white square-on-point configuration having the same dimensions as a hazard placard (all shown below).



  Paragraph 172.302(b) specifications for displaying the four-digit numbers. Section 172.332 has specs for placard, orange panel, and white square-on-point display.

- Each bulk package authorized by a **special permit** (remember we learned about special permits, also known as exemptions, in **MODULE 3**), must be marked DOT-E or DOT-SP followed by the assigned number of the exemption;

- The identification number and shipping name (if required) **must remain displayed when a bulk packaging is emptied**, unless cleaned of hazardous residue and purged of hazardous vapor;

- There are **additional specific marking** requirements for offering a shipment in a portable tank, cargo tank, tank car, bulk packaing containing sour crude oil, and other bulk packagings- check 172.326-331 for specifics.

- In the following cases, a **vehicle or freight container must be marked with the identification number** on all four sides:

  1) It contains equal to, or greater than 2,205 pounds of Zone A or B Inhalation Hazard materials (172.313(c));

2) It contains a full load (≥ 8820 lbs. gross) of non-bulk packages containing hazardous material of the same shipping name and ID number- see 172.301(a)(3) for details; or

3) It contains bulk packages of hazardous material (172.331(c)).

- A bulk packaging containing an **elevated temperature material** must be marked with the word "HOT" on a white square-on-point configuration in accordance with Section 172.325 (example shown below).

- In accordance with Section 173.9, the **FUMIGANT** marking (below) must be displayed on each railcar, truck body, trailer or freight container that has been fumigated, or is undergoing fumigation.

MODULE 9- Review Questions

1. The shipper must ensure that markings are-
    a) Clearly visible
    b) Capable of surviving open weather conditions without degradation
    c) Not obscured or overwhelmed by other information on the package
    d) In English
    e) All of the above

2. Every non-bulk packaging must be marked with the-
    a) Packing group
    b) Proper shipping name
    c) Identification number
    d) All of the above
    e) Both b and c

3. A package orientation marking (double arrows) is used for-
    a) Vented single packagings
    b) Open cryogenic gas containers
    c) Combination packagings containing liquids
    d) All of the above
    e) Both a and c

4. The consumer commodity marking must incorporate-
    a) The words, “retail products”
    b) The words “consumer commodity”
    c) “ ORM-D” or “ORM-D Air” within a rectangle
    d) All of the above
    e) Both b and c

5. The “Keep Away From Heat” marking is required for-
    a) Non-bulk air shipments of self-reactive Division 4.1 materials
    b) Non-bulk air shipments of self-heating Division 4.2 materials
    c) Non-bulk air shipments of organic peroxides
    d) All of the above
    e) Both a and c

6. Identification numbers on bulk packagings may be displayed-
    a) Within white panels
    b) Within orange panels
    c) Within hazard placards
    d) All of the above
    e) Both b and c

7. A closed truck trailer must display the identification number associated with-
    a) Each bulk packaging of hazardous material within the trailer
    b) Each organic peroxide of any quantity
    c) Each poison inhalation hazard of any quantity
    d) All of the above
    e) Both a and c

MODULE 10: Placarding

Placards are 10.8 inch per side, diamond-shaped (square-on-point) warning signs that look like large hazard labels- they are intended to warn emergency responders as to the hazards of the contents of bulk packages, vehicles, freight containers, rail cars and unit load devices.

The Placarding regulations do not apply to- infectious substances; consumer commodities (class ORM-D); and shipments prepared in accordance with exceptions which specifically except the shipment from placarding (such as the limited quantity, small quantity, and 172.13 exceptions discussed in **MODULE 6**).

General Application

Placards are Used in two broad applications-

1. They are used on bulk packagings, such as portable tanks and cargo tanks to identify the specific hazard(s) of the contents, similar to how a hazard label is used on smaller packagings. If a bulk packaging is emptied, the placard(s) still must be displayed, unless the packaging has been cleaned and purged to remove all hazards; and
2. On freight containers, vehicles, and aircraft unit load devices, placards are used to identify the hazards related to the packagings contained within.

Placarding Responsibilities- Highway

49 CFR 172.506

The offeror of a hazardous material for highway transport must provide the motor carrier the required placard(s) for the material being offered, unless the vehicle, freight container or bulk packaging is already placarded for that material.

The carrier may not transport a hazardous material unless the required placards are affixed.

Design Specifications

49 CFR 172.519-560

Placards must meet certain design specifications related to strength, durability, design, size and color. Images of each placard appear in Sections 172.521-560 and are shown in color in DOT Chart 13 (see downloadable attachments on your screen).

General Placarding Requirements

49 CFR 172.504

Each bulk packaging, freight container, unit load device, transport vehicle or rail car containing any quantity of a hazardous material must be placarded on each side and each end with the type of placards specified in **Tables 1 and 2** (below).

Table 1

Category of material (Hazard class or division number and additional description, as appropriate)	Placard name	Placard design section reference (§)
1.1	EXPLOSIVES 1.1	172.522
1.2	EXPLOSIVES 1.2	172.522
1.3	EXPLOSIVES 1.3	172.522
2.3	POISON GAS	172.540
4.3	DANGEROUS WHEN WET	172.548
5.2 (Organic peroxide, Type B, liquid *or* solid, temperature controlled)	ORGANIC PEROXIDE	172.552
6.1 (material poisonous by inhalation (see §171.8 of this subchapter))	POISON INHALATION HAZARD	172.555
7 (Radioactive Yellow III label only)	RADIOACTIVE[1]	172.556

Table 2

Category of material (Hazard class or division number and additional description, as appropriate)	Placard name	Placard design section reference (§)
1.4	EXPLOSIVES 1.4	172.523
1.5	EXPLOSIVES 1.5	172.524
1.6	EXPLOSIVES 1.6	172.525
2.1	FLAMMABLE GAS	172.532
2.2	NON-FLAMMABLE GAS	172.528
3	FLAMMABLE	172.542
Combustible liquid	COMBUSTIBLE	172.544
4.1	FLAMMABLE SOLID	172.546
4.2	SPONTANEOUSLY COMBUSTIBLE	172.547
5.1	OXIDIZER	172.550
5.2 (Other than organic peroxide, Type B, liquid or solid, temperature controlled)	ORGANIC PEROXIDE	172.552
6.1 (other than material poisonous by inhalation)	POISON	172.554
6.2	(None)	
8	CORROSIVE	172.558
9	Class 9 (see §172.504(f)(9))	172.560
ORM-D	(None)	

[1]RADIOACTIVE placard also required for exclusive use shipments of low specific activity material and surface contaminated objects transported in accordance with §173.427(b)(4) and (5) or (c) of this subchapter.

Exception for Less than 1,001 Pounds of Table 2 Materials- 172.504(c)

Except for bulk packagings and hazardous materials subject to §172.505 (subsidiary hazards which require placards), when hazardous materials covered by **Table 2** are transported by highway or rail, placards are not required on a transport vehicle or freight container which contains less than 454 kg (1001 pounds) aggregate gross weight of hazardous materials covered by Table 2.

Use of the DANGEROUS Placard- 172.504(b)

A freight container, unit load device, transport vehicle, or rail car which contains non-bulk packages with **two or more categories of hazardous materials** that require different placards specified in **Table 2** may be placarded with a DANGEROUS placard instead of the separate placarding specified.

However, when 1,000 kg (2,205 pounds) aggregate gross weight or more of one category of material is loaded therein at one loading facility on a freight container, unit load device, transport vehicle, or rail car, the placard specified in Table 2 must be applied.

Visibility and Display

49 CFR 172.516

This section describes the requirements related to how placards are displayed and maintained during transport, specifically, that placards-

- Must be visible from the direction they face
- On the front of a transport vehicle may be on the tractor front and/or the front of the cargo body
- Must be securely attached/affixed
- Must be clear of ladders, pipes, doors, and the like
- Must be, if practicable, located that they are not impacted by dirt or water from the wheels
- Must be located away from any markings that could reduce their effectiveness
- Must be maintained in good condition
- Must be affixed to a surface of contrasting background, or have a dotted or solid line outer border
- If in a placard holder or hinged, must comply with certain design specifications

Exceptions

49 CFR 172.504(f)

There are eleven exceptions for specific placarding situations. One of particular interest to offerors is that **Class 9 placards are not required** unless being used to display the identification number.

Special Circumstances

There are some very specific placarding rules related to placarding of- rail cars and tanks (172.508,172.510); highway route-controlled quantities of radioactives (172.507(a)); nurse tanks (172.507(b)); subsidiary hazards (172.505); explosives (172.504(g)); and freight containers and aircraft unit load devices (172.512).

MODULE 10- Review Questions

1. The shipper (offeror) must ensure that placards are-
    a) Displayed on a highway vehicle when applicable
    b) Made available to the carrier for categories of materials offered
    c) Made available to the carrier for all categories in the vehicle
    d) All of the above

2. A bulk packaging that is placarded-
    a) Must remain placarded until all hazardous residue/vapor is removed
    b) Must be placarded on one side only
    c) May display the Dangerous placard in place of an individual hazard
    d) All of the above
    e) Both a and c

3. A highway vehicle that requires placards, must have those placards displayed-
    a) On the rear and each side, at a minimum
    b) On all four sides
    c) On all four sides of a detached trailer, three-sides when attached
    d) On one side, at a minimum

4. The DANGEROUS placard may be used to-
    a) Substitute for any individual placard from placarding
    b) Substitute for two or more placards from placarding Table 2
    c) Substitute for two or more placards from placarding Table 1
    d) Identify mixed loads of hazardous and non-hazardous materials

5. An example of a category of hazardous material from placarding Table 1 is-
    a) Radioactive- category I
    b) Solid extremely poisonous by ingestion
    c) Pyrophoric material
    d) Dangerous when wet material
    e) Both b and c

MODULE 11: Shipping Papers

We are ready to describe our hazardous materials on a shipping paper. Shipping papers are another example of a resource of information that can be crucial to emergency responders in a hazmat incident.

Shipping papers describe the hazardous cargo, must be within an arm's reach of the driver during transport, and include important emergency response information and references. The hazardous materials descriptions need to have exactly the right elements and be entered in precisely the right manner- the requirements are varied and numerous.

Shipping papers come in various forms- some are standardized, while others are highly variable in look and format, examples include-

Uniform hazardous waste manifests
Medical/biological waste manifests
Bills of lading
Air waybills
Dangerous Goods Declarations (must also meet IATA regulation requirements)
Carrier-specific forms- e.g., FedEx Ground service forms OP-900 and 950

Regardless of the form, the information DOT is requiring is the same.

Applicability
49 CFR 172.200

Unless specifically excepted (such as with ORM-D, and Biological Substance, Category B shipments), each person who offers a hazardous material for transportation must describe the hazardous material on the shipping paper in the manner required.

Preparation of Shipping Papers
49 CFR 172.201-202

Basic Hazmat Description

The first required element of the shipping paper is the description of the materials being offered. In **MODULEs 4 and 5** we learned how to classify our materials, assign a packing group, determine the proper shipping name and look at entries in the hazardous materials table. The description includes the five basic descriptive elements of the material (shipping name, hazard class, subsidiary hazard, if applicable, identification number, and packing group).

Let's talk about the order and formatting of this description, and then we'll talk about other information that may be required. For this, we will use an example: acetic acid, glacial.

The basic description for this material would be entered as follows: "UN2789, Acetic acid, glacial, 8 (3), II". Notice that the subsidiary hazard is placed in parentheses and also notice the order, which is required. The individual elements may also be entered in separate columns so long as the order is correct. Technical names must be added for shipping names having a "G" entered in column 1 of the HMT, example: flammable liquids, n.o.s. (acetone, xylene).

Total Quantity Shipped

The total quantity in mass or volume must be entered, along with the unit of measure (standard abbreviations may be used). Beware! There are as many as twelve required variations on this basic rule. Check 172.202(a)(5)-(6) for your particular material type- specific requirements, include: when to use net vs. gross mass; how to declare cylinders, residue packages, articles, salvage packaging; and requirements specific to air, explosives, and radioactives.

Number & Type of Packaging

The number of packages and the type of each packaging must be declared on the shipping paper. For example: "12 drums", and "2 fiberboard boxes". When UN-specification packagings are used, the packaging ID code may also be inserted, for example: "12 1A1 drums", and "2 4G fiberboard boxes". The quantity and type must be entered after or before the basic description, but not in between any of the required basic description elements.

Examples of basic descriptions, quantities, and packaging types as they might appear on two shipping paper types are as follows:

Straight Bill of Lading

No. & Type of Shipping Units	HM	I.D. No.	PROPER DOT SHIPPING NAME	HAZARD CLASS	PG	TOTAL WEIGHT
1 steel drum	X	UN 1993	Flammable liquids, n.o.s. (xylene, ethanol)	3	II	500 LBS.
1 fiberboard box	X	UN 2509	Potassium hydrogen sulfate	8	II	28 LBS.
1 cylinder	X	UN 1001	Acetylene, dissolved	2.1		90 LBS.
1 wooden crate			500 ml. Glass sample bottles			8 LBS.

Uniform Hazardous Waste Manifest

GENERATOR	9a. HM	9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes		
	X	1. UN1090, Waste Acetone, 3, II	001	DM	00005	G	D001	F003	
	X	2. RQ, UN1993, Waste Flammable liquids, n.o.s. (ethyl ether, xylenes), 3, II	002	DM	00110	G	D001	F003	
	X	3. RQ, UN1824, Waste Sodium hydroxide solution, 8, III	002	DF	00110	G	D002		
		4. Non-RCRA, Non-DOT Material (State-regulated waste- used oil)	001	DM	00055	G	MA01		

***Note:** When hazardous and non-hazardous materials appear on the same bill of lading, then the hazardous material must either be entered first or must be entered in a contrasting color (highlighting can be substituted for colored ink or photocopies) or an "X" must appear in the HM column indicating the hazardous materials ("RQ" can be substituted for "X" when applicable).*

Additional Information

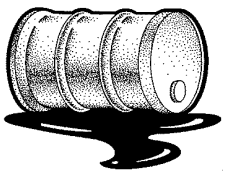
49 CFR 172.203

In specific cases, there is additional descriptive information required to be added to further describe the hazardous material. Those cases, and the paragraphs describing the specific requirements are as follows:

- the use of special permits- 172.203(a);
- the use of the limited quantity exception- 172.203(b);
- shipments of *hazardous substances*- 172.203(c);
- shipments of radioactives- 172.203(d);
- shipments of empty packagings- 172.203(e);
- rail shipments- 172.203(g);
- highway shipments of MC 330 and 331 cargo tanks having anhydrous ammonia or LP gas- 172.203(h);
- shipments of marine pollutants- 172.203(l);
- shipments of materials poisonous by inhalation- 172.203(m);
- shipments of elevated temperature materials- 172.203(n); and
- shipments of organic peroxides and self-reactive materials- 172.203(o).

Two of these specific shipment types warrant some additional explanation related to the definition of the material category and applicability, specifically- hazardous substances and marine pollutants.

The Hazardous Substances ("RQ") Rule



The U.S, Environmental Protection Agency (EPA) under the authority of the Comprehensive Environmental Response, Compensation and Liability Act (**CERCLA**), commonly known as the "Superfund" legislation, has identified a long list of materials that if released in appreciable quantities will cause significant harm to the environment. These materials are referred to as "hazardous

substances" and include **all EPA-regulated hazardous wastes** in addition to approximately 700 individual chemical compounds.

The reportable quantity **(RQ)** is that "appreciable" amount. If the amount of material spilled is equal to or in excess of the RQ value, then the spill could cause significant environmental harm and must be reported to the proper authorities. When such a spill involving a reportable quantity occurs, the individual that discovers the spill must report the release to the **National Response Center at 1-800-424-8802.**

Each hazardous substance has been assigned an RQ value in pounds. The RQ value is one of five possible values, each communicating a different degree of hazard to the environment if spilled.

To determine if the material to be shipped is defined as a hazardous substance and the its associated reportable quantity, the offeror must consult the *List of Hazardous Substances* in 172.101, Appendix A (excerpt shown below). If the material contains any constituent or hazardous waste code in an amount equal to or exceeding its reportable quantity by weight in an individual package, then **"RQ"** must be added before or after the basic description. Additionally, the name of the hazardous substance(s) exceeding the RQ must also be entered in parentheses (if not already included in the shipping name).

TABLE 1 TO APPENDIX A—HAZARDOUS SUBSTANCES OTHER THAN RADIONUCLIDES—Continued

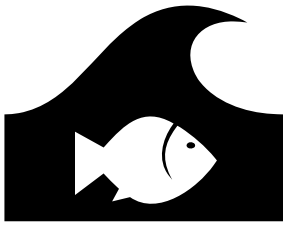
Hazardous substance	Reportable quantity (RQ) pounds (kilograms)
Acetaldehyde, trichloro-	5000 (2270)
Acetamide	100 (45.4)
Acetamide, N-(aminothioxomethyl)-	1000 (454)
Acetamide, N-(4-ethoxyphenyl)-	100 (45.4)
Acetamide, N-9H-fluoren-2-yl-	1 (0.454)
Acetamide, 2-fluoro-	100 (45.4)
Acetic acid	5000 (2270)
Acetic acid, (2,4-dichlorophenoxy)-, salts & esters	100 (45.4)
Acetic acid, ethyl ester	5000 (2270)
Acetic acid, fluoro-, sodium salt	10 (4.54)
Acetic acid, lead(2+) salt	10 (4.54)
Acetic acid, thallium(1+) salt	100 (45.4)
Acetic acid, (2,4,5-trichlorophenoxy)-	1000 (454)
Acetic anhydride	5000 (2270)
Acetone	5000 (2270)
Acetone cyanohydrin	10 (4.54)
Acetonitrile	5000 (2270)

Note: There is also a hazardous substances list (172.101, App. A- Table 2) which show the RQ thresholds for radionuclides.

Hazardous Substances Example:

A material consists of a mixture of equal amounts of two flammable solvents- acetone and xylene, and is being shipped in a 55 gallon drum with a net contents weight of 450 pounds. Therefore, each constituent is in an amount of 225 lbs. In this example, two constituents need to be searched in the Hazardous Substances List- 172.101, App. A. The information in the list shows us that both constituents are listed as follows: Acetone: RQ = 5,000 lbs.; Xylene: RQ = 100 lbs. In this case, the "RQ" designation needs to be added to the shipping description because at least one constituent exceeds it's listed reportable quantity. The shipping description becomes: ***RQ, UN1993, Flammable liquids, n.o.s. (acetone, xylenes), 3, UN1993, II.***

The Marine Pollutants Rule



A marine pollutant is a material which contains one or more chemical constituents listed in the marine pollutants list (Section 172.101, Appendix B- excerpt shown below) in a concentration which equals or exceeds 10% by weight. If the chemical constituent is identified as a severe marine pollutant (designated "PP" on the marine pollutants list), then the concentration threshold is lowered to 1% or more by weight.

Marine pollutants must be identified on the shipping paper with the words "marine pollutant" in association with the basic description.

Note: The requirements of the HMR specific to marine pollutants do not apply to non-bulk packagings transported by highway, rail or aircraft.

LIST OF MARINE POLLUTANTS—Continued

S.M.P. (1)	Marine pollutant (2)
	Alcohol C-6 - C-17 (secondary)poly(3-6) ethoxylate
	Aldicarb
PP	Aldrin
	Alkyl (c12-c14) dimethylamine
	Alkyl (c7-c9) nitrates
	Alkybenzenesulphonates, branched and straight chain (*excluding C11–C13 straight chain or branched chain homologues*)
	Allyl bromide
	ortho-Aminoanisole
	Aminocarb
	Ammonium dinitro-o-cresolate
	n-Amylbenzene
PP	Azinphos-ethyl
PP	Azinphos-methyl
	Barium cyanide

LIST OF MARINE POLLUTANTS—Continued

S.M.P. (1)	Marine pollutant (2)
	Chlorodinitrobenzenes, liquid or solid
	1-Chloroheptane
	1-Chlorohexane
	Chloronitroanilines
	Chloronitrotoluenes, *liquid*
	Chloronitrotoluenes, *solid*
	1-Chlorooctane
PP	Chlorophenolates, liquid
PP	Chlorophenolates, solid
	Chlorophenyltrichlorosilane
	Chloropicrin
	alpha-Chloropropylene
	Chlorotoluenes (meta-;para-)
PP	Chlorpyriphos
PP	Chlorthiophos
	Cocculus

Emergency Response Information

49 CFR 172.602-604

Emergency response information that accompanies a shipment of hazardous material while in transit is applicable to those who offer, accept, or transfer, or otherwise handle hazardous materials. The two principle requirements are: written emergency information, and a 24-hour emergency response telephone number.

Emergency Response Information in Written Form

Section 172.602 requires that the following written emergency response information be immediately available for use at all times the material is present:

1. basic description (as described earlier in this MODULE)
2. immediate health hazards
3. risks of fire and explosion
4. immediate precautions in an accident or incident
5. immediate fire-handling methods
6. immediate non-fire spill handling methods
7. preliminary first aid measures

The information may be entered on the shipping paper or in an accompanying document or guide book, such as the DOT Emergency Response Guidebook.

24 Hr. Emergency Response Telephone Number

A person who offers a hazardous material for transportation must provide an emergency response telephone number, including the area code or international access code, for use in the event of an emergency involving the hazardous material.

The telephone number must be—

1. Monitored at all times the hazardous material is in transportation, including storage incidental to transportation;

2. The telephone number of a person who is either knowledgeable of the hazardous material being shipped and has comprehensive emergency response and incident mitigation information for that material, or has immediate access to a person who possesses such knowledge and information. A telephone number that requires a call back (such as an answering service, answering machine, or beeper device) does not meet the requirements of paragraph (a) of this section; and

3. Entered on a shipping paper, as follows:
    - Immediately following the description of the hazardous material required by subpart C of this part; or
    - Entered once on the shipping paper in a clearly visible location. This provision may be used only if the telephone number applies to each hazardous material entered on the shipping paper, and if it is indicated that the telephone number is for emergency response information (for example: “EMERGENCY CONTACT: * * *).

The telephone number must be the number of the person offering the hazardous material for transportation or the number of an agency or organization capable of, and accepting responsibility for, providing the detailed information concerning the hazardous material. A person offering a hazardous material for transportation who lists the telephone number of an agency or organization shall ensure that agency or organization has received current information on the material before it is offered for transportation.

Shipper’s Certification Statement

49 CFR 172.204

Each person who offers a hazardous material for transportation must certify that the material is offered for transportation in accordance with the regulations by printing (manually or mechanically) on the shipping paper one of the following two certification statements:

“This is to certify that the above-named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.”;

Or-

"I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations."

Additional Certification Language for Air Transport

For transportation by air, certification containing the following language (having an additional statement related to proper condition for air transport) may be used in place of the aforementioned certification statements:

"I hereby certify that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packaged, marked and labeled, and in proper condition for carriage by air according to applicable national governmental regulations."

Certification for Radioactives Offered by Passenger Air

Each person who offers any radioactive material for transportation aboard a passenger-carrying aircraft must sign (mechanically or manually) a printed certificate stating that the shipment contains radioactive material intended for use in, or incident to, research, or medical diagnosis or treatment.

Recordkeeping

49 CFR 172.201(e)

Each person who provides a shipping paper must retain a copy of the shipping paper, or an electronic image thereof, that is accessible at or through its principal place of business and must make the shipping paper available, upon request, to an authorized official of a Federal, State, or local government agency at reasonable times and locations.

For a hazardous waste, the shipping paper copy must be retained for three years after the material is accepted by the initial carrier. For all other hazardous materials, the shipping paper must be retained for **two years** after the material is accepted by the initial carrier.

Each shipping paper copy must include the date of acceptance by the initial carrier, except that, for rail, vessel, or air shipments, the date on the shipment waybill, airbill, or bill of lading may be used in place of the date of acceptance by the initial carrier.

A motor carrier (as defined in §390.5 of subchapter B of Chapter III of subtitle B) using a shipping paper without change for multiple shipments of one or more hazardous materials having the same shipping name and identification number may retain a single copy of the shipping paper, instead of a copy for each shipment made, if the carrier also retains a record of each shipment made, to include shipping name, identification number, quantity transported, and date of shipment.

MODULE 11- Review Questions

1. The basic description on a shipping paper is in the following order-
    a) Shipping name, Class or Division, Packing Group, ID number
    b) ID number, Shipping name, Class or Division, Packing Group
    c) ID number, Class or Division, Shipping name, Packing Group
    d) ID number, Class or Division, Packing Group, Shipping name

2. An acceptable method for declaring the number and type of packaging is-
    a) 4 steel drums
    b) 4 1A1
    c) 4 units
    d) 4 1A1 steel drums
    e) Both a and d

3. Emergency response information associated with the shipping paper includes:
    a) Preliminary first aid measures
    b) Risks of fire and explosion
    c) Immediate health hazards
    d) All of the above
    e) Both b and c

4. The shipper's certification statement-
    a) Must include an additional statement when offered by air
    b) Must include the phrase, "punishable by imprisonment"
    c) Is not required for domestic hazardous material shipments
    d) All of the above
    e) Both a and c

5. Hazardous and non-hazardous materials described on the same shipping paper must be-
    a) Differentiated by color
    b) Differentiated by listing the hazardous materials first
    c) Differentiated by marking the "HM" column for hazardous entries
    d) Any of the above
    e) Both a and b

6. The "RQ" designation associated with an individual packaging indicates-
    a) A constituent and/or EPA waste code exceeds the RQ value
    b) A release of the material would trigger notification to the NRC
    c) The material meets the definition of a "hazardous substance"
    d) All of the above
    e) Both b and c

7. Shipping papers for past shipments must be retained by the shipper for-
    a) 5 years minimum
    b) 3 years minimum
    c) 2 years minimum
    d) 375 days minimum

MODULE 12: Loading & Unloading

Active loading and/or loading of a transport vehicle is included in the cycle of transportation and therefore falls under the mode-specific parts of the regulations. Loading of a highway vehicle, for example falls under Part 177-*carriage by highway*. The provisions of these carrier-specific Parts apply to those who perform functions covered by the Parts, including shippers performing certain tasks. We're going to concentrate on those activities shippers often get involved in, namely loading highway transport vehicles with packagings and the associated compliance issues that are involved.

Loading and Unloading

49 CFR 177, Subpart B

The following must be ensured while loading and unloading highway transport vehicles with hazardous materials:

Packages must be **secured in the vehicle** to prevent shifting during transport. Packages having **Valves and other fittings** must be loaded in a manner to minimize the likelihood of damage during transport.

Packages must be oriented in accordance with the **package orientation** marking.

There must be **no smoking and ignition sources kept away** when loading explosive, flammable or oxidizing materials.

The **the handbrake must be set and all other precautions** taken against movement of the vehicle during loading/unloading; and no damaging tools be used to load explosives or other dangerous materials.

Additionally, there many additional specific requirements in Subpart B for loading of certain materials, and include provisions for loading and unloading-

- cargo tanks;
- packages of nitric acid;
- pyrophoric liquids;
- corrosives;
- gases;
- inhalation hazards; and of course; and
- very specific requirements for radioactives.

Segregation Table

49 CFR 177.848

Each package within a highway transport vehicle that must be labeled/placarded must be segregated in accordance with the following segregation table:

Highway Segregation Table for Hazardous Materials

Class or division		Notes	1.1 1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3 gas zone A	2.3 gas Zone B	3	4.1	4.2	4.3	5.1	5.2	6.1 liquids PG I zone A	7	8 liquids only
Explosives	1.1 and 1.2	A	*	*	*	*	*	X	X	X	X	X	X	X	X	X	X	X	X	X
Explosives	1.3		*	*	*	*	*	X		X	X	X		X	X	X	X	X		X
Explosives	1.4		*	*	*	*	*	O		O	O	O		O				O		O
Very insensitive explosives	1.5	A	*	*	*	*	*	X	X	X	X	X	X	X	X	X	X	X	X	X
Extremely insensitive explosives	1.6		*	*	*	*	*													
Flammable gases	2.1		X	X	O	X				X	O							O	O	
Non-toxic, non-flammable gases	2.2		X			X														
Poisonous gas Zone A	2.3		X	X	O	X		X				X	X	X	X	X	X			X
Poisonous gas Zone B	2.3		X	X	O	X		O				O	O	O	O	O	O			O
Flammable liquids	3		X	X	O	X				X	O					O		X		
Flammable solids	4.1		X			X				X	O							X		O
Spontaneously combustible materials	4.2		X	X	O	X				X	O							X		X
Dangerous when wet materials	4.3		X	X		X				X	O							X		O
Oxidizers	5.1	A	X	X		X				X	O	O						X		O
Organic peroxides	5.2		X	X		X				X	O							X		O
Poisonous liquids PG I Zone A	6.1		X	X	O	X		O				X	X	X	X	X	X			X
Radioactive materials	7		X			X		O												
Corrosive liquids	8		X	X	O	X				X	O		O	X	O	O	O	X		

Instructions for Using the Segregation Table

The absence of any hazard class or division or a blank space in the table indicates that no restrictions apply.

The **letter "X"** in the table indicates that these materials may not be loaded, transported, or stored together in the same transport vehicle or storage facility during the course of transportation.

The **letter "O"** in the table indicates that these materials may not be loaded, transported, or stored together in the same transport vehicle or storage facility during the course of transportation unless separated in a manner that, in the event of leakage from packages under conditions normally incident to transportation, commingling of hazardous materials would not occur. Notwithstanding the methods of separation employed, Class 8 (corrosive) liquids may not be loaded above or adjacent to Class 4 (flammable) or Class 5 (oxidizing) materials; except that shippers may load truckload shipments of such materials together when it is known that the mixture of contents would not cause a fire or a dangerous evolution of heat or gas.

The **"*"** in the table indicates that segregation among different Class 1 (explosive) materials is governed by the compatibility table in paragraph (f) of this section.

The note **"A"** in the second column of the table means that, notwithstanding the requirements of the letter "X", ammonium nitrate (UN 1942) and ammonium nitrate fertilizer may be loaded or stored with Division 1.1 (explosive) or Division 1.5 materials.

Subsidiary Hazard Segregation

When the §172.101 table or §172.402 of this subchapter requires a package to bear a subsidiary hazard label, segregation appropriate to the subsidiary hazard must be applied when that segregation is more restrictive than that required by the primary hazard. However, hazardous materials of the same class may be stowed together without regard to segregation required for any secondary hazard if the materials are not capable of reacting dangerously with each other and causing combustion or dangerous evolution of heat, evolution of flammable, poisonous, or asphyxiant gases, or formation of corrosive or unstable materials.

Explosives Segregation

49 CFR 177.848(f)

Class 1 (explosive) materials must not be loaded, transported, or stored together in accordance with the explosives segregation requirements and table of 177.848(f).

Additional Segregation Requirements

49 CFR 177.848

In addition to the segregation table, the following additional segregation requirements must be followed:

- In accordance with paragraph 177.848(c), **cyanides and acids** may not be stored, loaded and transported together if the mixture would liberate HCN gas.
- In accordance with paragraph 177.848(e)(3), **Division 4.2 and Class 8** materials may not be stored, loaded and transported together, and **Class 8** materials cannot be loaded above or adjacent to **Class 4 and Class 5** materials.

Additional Requirements Specific to Hwy. Vehicle Drivers

49 CFR 177, Subpart A, D, E

Highway vehicle drivers must comply with specific provision in Part 177 which are specific to drivers, including-

Carrier's responsibility for compliance with regard to-
Unnecessary delay of movement;
Rejection of unacceptable shipments;
Having loads available for inspection;
Federal Motor Carrier Safety Regulations;
Tunnels;
Driver training;
Shipping papers;
Movement of vehicles in emergency situations;
Disabled vehicles;
Broken and leaking packages;
Overpacking and repair of packages;
Repair and maintenance of vehicles; and
Passenger carrying vehicles

MODULE 12- Review Questions

1. While loading or unloading hazardous materials-
    a) Highway vehicles must be prevented from moving
    b) There must be no smoking
    c) A powered industrial truck must not be used
    d) All of the above
    e) Both a and b

2. Individuals loading hazardous materials on a highway vehicle-
    a) Are not responsible for segregation if not the driver of the vehicle
    b) Must not load Class 8 materials adjacent to Class 4 or 5 materials
    c) Must not load cyanides adjacent to flammable liquids
    d) All of the above
    e) Both b and c

3. According to the highway segregation table, a flammable liquid-
    a) Must be segregated from a Division 5.1
    b) Must not be loaded on the same vehicle with a Division 5.2
    c) Must be segregated from a Division 2.2
    d) None of the above