

A photograph of a warehouse interior. A yellow forklift is carrying a large white Intermediate Bulk Container (IBC) on its forks. A worker wearing a high-visibility vest and a cap is operating the forklift. The IBC has two diamond-shaped hazard labels with the number '1760'. The background shows warehouse shelving and other boxes.

Loading and Unloading HM

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OBJECTIVES

Upon completion of this chapter, you will be able to:

- Discuss general loading and unloading requirements
- Describe loading and unloading requirements for specific hazard classes

Introduction

Loading and unloading hazardous materials (hazmat) from a vehicle may seem like a fairly common task. However, if it's done in a haphazard manner or if it's done improperly, the results could be disastrous. In this chapter, you will learn some vital procedures you need to take during the loading and unloading process to minimize the potential of a mishap.

General Loading & Unloading Requirements

Certain procedures must be followed when loading and unloading hazardous materials from your vehicle. These procedures, as set out in the Hazardous Materials Regulations (HMR), are intended to protect you and others around your vehicle during the loading and unloading process.

Set Parking Brake — During the loading and unloading of any hazardous materials, the vehicle's parking brake must be set. In most cases, it's also a good idea to chock the wheels to prevent the vehicle from moving or shifting in the event of a brake failure. All precautions must be taken to prevent movement of the vehicle.

Tools — Any tools used in loading or unloading hazardous materials must be used with care so as not to harm packages or damage closures on packages or containers. To reduce the chances of a fire, it's also a good idea to use tools that have low or no spark properties.

No Smoking — Smoking on or near any vehicle while loading or unloading any Class 1 (explosives), Class 3 (flammable and combustible liquid), Class 4 (flammable solid), Class 5 (oxidizer), or **Division 2.1** (flammable gas) is forbidden. Care should be taken to keep all fire sources (matches and smoking materials in particular) away from any vehicle hauling these materials.

Orientation Markings — Packages that display orientation markings such as "This Side Up" or up arrows, must be loaded according to those markings. Those packages must also remain in the correct position as indicated by the markings throughout the transportation process.

Securing Packages — Packages containing any hazardous materials not permanently attached to a vehicle must be secured against any movement, including shifting or movement between packages during normal transportation. Packages having valves or other fittings must be loaded in a way that minimizes the chances of damaging the valve or fitting during transportation.



Division: A subdivision of a hazard class.

Cargo Heaters — Typically the regulations do not allow Class 1 (explosives), Division 2.1 (flammable gases), and Class 3 (flammable liquids) to be loaded or transported in transport units equipped with cargo heaters (including automatic cargo heater/air conditioner units) unless the cargo heater is rendered inoperable by:

1. Draining or removing the cargo heater fuel tank
2. Disconnecting the heater's power source

Attendance Requirements — **Cargo tanks** must always be monitored by a **qualified person** during the loading or unloading process. The person monitoring this process must be within 25 feet of the cargo tank and must have an unobstructed view of the delivery hose transfer area.

Once the loading or unloading process is complete, the driver must make sure that all manhole covers and valves are securely closed. Drivers must also walk around the cargo tank to ensure there are no leaks prior to moving the cargo tank.

Segregation — To prevent non-compatible hazardous materials from reacting with each other, the HMR contain segregation requirements that indicate which hazardous materials may not be loaded, transported, or stored together. Hazardous materials which are in packages that require labels, in a compartment within a multi-compartmented cargo tank, or in a portable tank loaded in a transport vehicle or freight container are subject to the segregation requirements.



Hazardous materials may not be loaded, transported, or stored together, except as provided in the hazmat segregation table on page 58. This helps to ensure nothing happens to endanger life or property during the transportation process.

In addition to the segregation table, cyanides and cyanide mixtures or solutions may not be stored, loaded, or transported with acids if a mixture of the materials would generate hydrogen cyanide.

Also, Division 4.2 materials may not be stored, loaded, or transported with Class 8 liquids, and a Division 6.1 Packing Group I, Hazard Zone A material may not be stored, loaded, or transported with Class 3 material, Class 8 liquids, and Division 4.1, 4.2, 4.3, 5.1, or 5.2 material.

Cargo tank: Any trailer on which tanks are mounted to contain fluid commodities in bulk, tanks may contain baffles to stop liquid from surging while in motion, pumps for loading/unloading may be self-contained.

Qualified person: A person that has been made aware of the nature of the hazardous material, has been instructed on the procedures to be followed in the event of an emergency, and is authorized to move the cargo tank and has the means to do so.

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	X	X	X
Explosives 1.4		*	*	*	*	*	O	O	O	O	O	O	O	O	O	O	O	O	O
Very insensitive 1.5 explosives	A	*	*	*	*	*	X	X	X	X	X	X	X	X	X	X	X	X	X
Extremely insensitive 1.6 explosives		*	*	*	*	*													
Flammable gases 2.1		X	X	O	X			X	O								O	O	
Non-toxic, 2.2 non-flammable gases		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 4.2 combustible materials		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 PGI 6.1 Zone A		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	O	X		

To use the table:

- Locate the hazard classes or divisions of the materials you are loading—one in the vertical column, the other in the horizontal row

Note: If the classes or divisions are not listed in the table, there are not segregation restrictions.

- Follow each to the location where they intersect
- The codes at the intersection are defined as follows:

Code	Meaning
Blank	The materials may be loaded, stored, or transported together.
X	The materials may not be loaded, stored, or transported together.
O	The materials may not be loaded, stored, or transported together unless separated so that—in the event of leakage—there will be no mixing of the materials. However, Class 8 (corrosive) liquids may not be loaded above or adjacent to Class 4 (flammable) or Class 5 (oxidizing) materials, except when it is known the mixture of the contents would not cause a fire or a dangerous evolution of heat or gas.
*	Class 1 (explosive) materials must be segregated in accordance with the Compatibility Table for Class 1 materials. (See 49 CFR 177.848(f) of the HMR.)
A	Ammonium nitrate (UN1942) and ammonium nitrate fertilizer may be loaded or stored with Division 1.1 or 1.5 materials.

Loading & Unloading Requirements for Specific Hazard Classes

Certain hazard classes have specific requirements that must be met during the loading and unloading process. These requirements must be used in conjunction with the general loading and unloading requirements previously mentioned.

Class 1 (explosives) — Before you load or unload Class 1 materials there are a few tasks you must complete:

- Turn the vehicle's engine off
- Disable and disconnect any cargo heaters
- Drain cargo heater fuel tanks
- Inspect the cargo area for protruding nails, bolts, screws, or anything that could damage the packaging
- Division 1.1, 1.2, and 1.3 (explosives) must have a nonmetallic or **nonferrous metal** lining in the cargo area



During the loading or unloading process, you must never:

- Use **bale hooks** or other metal tools
- Drop, throw, or roll packages
- Transfer Division 1.1, 1.2, and 1.3 (explosives) on a public roadway except in an emergency

Note: If safety requires an emergency transfer, set out red warning reflectors, flags, or electric lanterns.

- Transport Division 1.1 or 1.2 (explosives) in triples or in vehicle combinations if:
 - There is a marked or placarded cargo tank in the combination
 - The other vehicle in the combination contains:
 - Division 1.1 A (initiating explosives)
 - Packages of Class 7 (radioactive) materials labeled "Yellow III"
 - Division 2.3 (poisonous gas) or Division 6.1 (poisonous) material
 - Hazardous materials in a portable tank, on a Department of Transportation (DOT) Spec 106A or 110A tank

Nonferrous metal:

A metal, including alloys, that does not contain iron. Examples of nonferrous metals are aluminum, copper, lead, and nickel.

Bale hook: A hand tool used for moving loads. It generally consists of a wooden handle with a strong metal hook about 8" long projecting at a right angle from the center of the handle. A bale hook is also referred to as a box hook, cargo hook, or a loading hook.

Vapor space: The area in a container that is provided for the expansion of vapors.

Class 2 (compressed gases) — The cargo floor of the vehicle transporting cylinders must be flat. Cylinders must be securely restrained in an upright or horizontal position, loaded in racks, or packed in boxes or crates to prevent the cylinders from being shifted, overturned, or ejected from the vehicle under normal transportation conditions. A pressure relief device, when installed, must be in contact with the **vapor space** of a cylinder containing a Division 2.1 (flammable gas) material.

Portable tanks must be loaded onto a flat floor, platform, or onto a suitable frame of a vehicle. Drivers must also make sure the portable tank is properly blocked, braced, or secured to prevent movement during transportation.

Division 2.1 (flammable gas) materials must not be loaded or unloaded from any cargo tank motor vehicles with the engine running unless the engine is used for the operation of the transfer pump of the vehicle. If the delivery hose is equipped with a shut-off valve at its discharge end, the engine of the vehicle must be shut off when finished loading or unloading while you disconnect the filling or discharge connections.

Cargo tank vehicles that transport Chlorine must be equipped with an appropriate gas mask and emergency kit for controlling leaks in fittings on the dome cover plate.

Class 3 (flammable liquids) — Drivers operating cargo tanks of Class 3 materials must turn off the vehicle's engine unless the engine of the vehicle is used to operate the pump. The diesel engine of a cargo tank motor vehicle may be left running during the loading and unloading of a Class 3 material if the ambient atmospheric temperature is at or below 10 °F (–12 °C). In most cases, cargo tanks must be bonded or **grounded** prior to and during loading or unloading Class 3 materials.



Class 4 (flammable solids) and Class 5 (oxidizing) — Class 4 and 5 materials that become unstable and dangerous when wet, must be kept dry while in transit and during loading and unloading. These materials must be completely enclosed in a vehicle or covered securely. Materials that are subject to spontaneous combustion or heating must be in vehicles with sufficient ventilation.

Division 6.1 (poisonous) and Division 2.3 (poisonous gas) — Drivers must never load a package labeled POISON or POISON INHALATION HAZARD in the driver's cab or sleeper berth. When loading or unloading bulk quantities of "arsenical dust," "arsenic trioxide," and "sodium arsenate," all practical means must be taken to reduce the spread of dust.

In most cases, packages labeled POISON or POISON INHALATION HAZARD must not be loaded in the same vehicle as foodstuffs, feed, or edible material intended for consumption by humans or animals.

Grounded: Connected to the Earth or to some conducting body that serves in place of the Earth.

Class 7 (radioactive materials) — Materials loaded on any transport vehicle must be limited so the total transport index number does not exceed 50. The total transport index of a group of packages and overpacks is determined by adding together the transport index number on the labels of the individual packages and overpacks in the group.

Packages labeled with “RADIOACTIVE YELLOW-II” or “RADIOACTIVE YELLOW-III” labels may not be placed in a transport vehicle closer than the distances shown in the following table to any area which may be continuously occupied by any passenger, employee, animal, or any package containing undeveloped film.

Total transport index	Minimum separation distance in meters (feet) to the nearest undeveloped film in various times of transit					Minimum distance in meters (feet) to are of persons, or minimum distance in meters (feet) from dividing partition of cargo compartments
	Up to 2 hours	2-4 hours	4-8 hours	8-12 hours	Over 12 hours	
None	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
0.1 to 1.0	0.3 (1)	0.6 (2)	0.9 (3)	1.2 (4)	1.5 (5)	0.3 (1)
1.1 to 5.0	0.9 (3)	1.2 (4)	1.8 (6)	2.4 (8)	3.4 (11)	0.6 (2)
5.1 to 10.0	1.2 (4)	1.8 (6)	2.7 (9)	3.4 (11)	4.6 (15)	0.9 (3)
10.1 to 20.0	1.5 (5)	2.4 (8)	3.7 (12)	4.9 (16)	6.7 (22)	1.2 (4)
20.1 to 30.0	2.1 (7)	3.0 (10)	4.6 (15)	6.1 (20)	8.8 (29)	1.5 (5)
30.1 to 40.0	2.4 (8)	3.4 (11)	5.2 (17)	6.7 (22)	10.1 (33)	1.8 (6)
40.1 to 50.0	2.7 (9)	3.7 (12)	5.8 (19)	7.3 (24)	11.0 (36)	2.1 (7)

Class 8 (corrosive) — Nitric acid in concentrations of 50 percent or greater must not be loaded above any other materials. Batteries containing **liquid electrolytes** must be loaded in an upright position to prevent the liquid from spilling. Battery terminals must be protected from damage and precautions taken to prevent short circuits.

Liquid electrolytes:

A sulfuric acid solution used in wet storage batteries.

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Chapter 4: Loading and Unloading HM Quiz

Directions: Read each statement carefully and mark the response that best answers the question.

- 1. Packages that display orientation markings must _____ as indicated by the markings throughout the transportation process.**
 - A. be moved periodically
 - B. remain in the correct position
 - C. be handled with long-handle tools
 - D. both A and B.

- 2. When are you allowed to haul Class 1 (explosives), Division 2.1 (flammable gases), or Class 3 (flammable liquids) in a transport unit equipped with a cargo heater?**
 - A. Only if you render the cargo heater inoperable by draining or removing its fuel tank and disconnecting the power source
 - B. Only after you verify the load is properly secured and at least 15 feet from the cargo heater
 - C. You are never allowed to transport any hazmat in a unit equipped with a cargo heater
 - D. Anytime, as long as you unplug the cargo heater

- 3. What hazardous materials are subject to segregation requirements?**
 - A. Any hazmat that is in a package that requires a label
 - B. Any hazmat in a compartment within a multi-compartmented cargo tank
 - C. All cyanides and cyanide mixtures or solutions
 - D. All of the above

4. When loading or unloading Class 1 (explosives), you must:

- A. turn the vehicle engine off.
- B. drain cargo heater fuel tanks.
- C. ensure all explosives are facing the same direction.
- D. both A and B.

5. Which materials must be kept dry while in transit and during the loading and unloading process?

- A. Radioactive materials
- B. Nitric acid
- C. Class 4 (flammable solids) and Class 5 (oxidizers)
- D. Class 2 (compressed gases)

SAMPLE