



**DANGEROUS**  
**GOODS** A DIVISION OF  
BERLIN PACKAGING



## SHIPPING HAZARDOUS MATERIALS

A How-To Guide to Compliance

### EXECUTIVE SUMMARY

Hazardous materials are essential to our economy. These materials include everything from paints and batteries to explosives and caustic chemicals to infectious substances. Even some of the cosmetics and perfumes sitting on your counter at home can be classified as dangerous goods. No matter the use, hazardous materials must be handled with care. There are special regulations and procedures with which to comply when these goods are shipped by air, ground, rail, and sea. In this paper, we highlight the principal regulations as well as provide a step-by-step guide to shipping hazardous materials in a manner that's safe and compliant with all regulations.

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## INTRODUCTION

Hazardous materials need special handling. There are numerous regulations and requirements outlining proper care for dangerous goods while on site and also in transit.

Non-compliance with hazardous material shipping regulations can be costly. Recently, the FAA proposed a \$140,000 fine against a major retailer due to improper shipping-paper declarations for the hazardous materials in their 3 oz bottles of nail color and 5 oz containers of sun block; the nail color should have been classified as a flammable liquid and the sun block a flammable gas. And a leading pharmaceutical distribution company received a \$91,000 fine because they made an undeclared shipment of skin care products containing alcohol.

And it's not just problems with shipping declarations; there are many possible failure points when transporting hazardous materials as we will see below.

In order to help companies perfectly comply with the regulations, this paper provides a how-to guide to compliance for companies shipping hazardous materials. The paper is organized into three principal sections:

- **Regulatory summary** – we review the major legislation and governance regarding shipping hazardous materials.
- **Step-by-step guide** – we outline a reliable approach to ensure you stay within the requirements.
- **Useful partners** – we describe companies that can help you master the process and deliver advantages in execution.

Before we begin with the regulatory overview, we first turn to some common mistakes companies make when shipping hazardous materials (or dangerous goods – we will use the terms interchangeably).

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## COMMON MISTAKES

There are many pitfalls companies can encounter when shipping dangerous goods. Some mistakes include a failure to:

- **Understand the regulations related to variation packaging and the corresponding "4GV Mark."** Ignorance is not bliss when dangerous goods are involved.
- **Ship the package as it was tested.** Each approved packaging solution must be used in exactly the same configuration as what was originally tested.
- **Use a leakproof bag when shipping liquids.** Special bags are required in conjunction with rigid containers when shipping liquids by air.
- **Use enough cushioning or absorbent material.** A dangerous goods packaging system only works when all of the intended components are present. Cushioning and absorbents are necessary parts of certain systems.
- **Pressure-test primary or secondary packaging when liquid material is to be shipped by air.** Not all packages are suitable for air transport.
- **Close the container with the proper torque or follow closing instructions.** Packaging systems are designed and tested to work with specific closing torque. Not following torque or

other closing instructions can violate the integrity of the entire system.

- **Make complete declarations on shipping papers.** Airlines and other carriers need to know what they are transporting to ensure safety.
- **Train employees (and keep training certifications current).** There are rigorous training standards for all employees involved in handling dangerous goods.

How well a company is prepared to avoid making mistakes depends on their understanding of the regulatory environment as well as the integrity of their internal processes and controls. These are the items to which we now turn.

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## REGULATORY SUMMARY

There are multiple regulations a shipper of hazardous materials needs to know. We will provide a quick overview of the most essential regulations in the United States – the 49 CFR – and also touch on a series of regulations that are important in the international community.

### 49 CFR

#### ***What it is***

The Code of Federal Regulations, Title 49, governs the domestic transportation of hazardous materials for all modes of transport to, from, and within the United States.

#### ***Who is responsible for it***

Title 49 is composed of nine volumes. The volumes containing Parts 100-185 for the transportation of hazardous materials are overseen by the Pipeline and Hazardous Materials Safety Administration, which is part of the U.S. Department of Transportation.

#### ***What it says***

The 49 CFR addresses key protocols for preparing, shipping, and handling dangerous goods. Any person handling dangerous goods should read, understand, and comply with all elements of the 49 CFR. Some of the highlights include:

- The description of hazardous materials by class, including explosives, gases, flammable and combustible liquids and solids, poisons, radioactive materials, and corrosive agents.
- The amount of hazardous materials permitted in certain primary containers as well as the total volume per shipped package.
- The types of packages and packaging required to safely transport hazardous materials.
- Testing requirements needed to reach specific performance standards.
- The documentation required when shipping hazardous materials.
- The markings and labels required on packaging and the placards required by the carrier.
- Training and safety plan requirements.

For each type of hazardous material, there are specific rules, and it is the role of the shipper to understand the requirements. In particular, Part 173.22 outlines the shipper's responsibility in

preparing hazardous materials for transportation. Among other things, the shipper must ensure:

- The product is classified and described properly.
- The package or container is an authorized package including being manufactured, assembled, packed, and marked in accordance to regulations.
- The package has met all the testing requirements listed in Part 178.

**Where to find it**

You can find the entire 49 CFR at [Phmsa.dot.gov/regulations](https://www.phmsa.dot.gov/regulations).

## United Nations Model Regulations

**What it is**

Outside the United States, the UN Model Regulations provide international guidelines regarding all aspects of transporting dangerous goods. International rules do not always harmonize with U.S. regulations, so it's important to understand these UN guidelines if you are shipping goods outside the United States. The UN Model Regulations are not obligatory or legally binding within individual countries, but they have gained a wide degree of international acceptance.

**Who is responsible for it**

The UN Regulations are created by the Transport of Dangerous Goods sub-committee of the United Nations Economic and Social Council.

**What it says**

As with the 49 CFR, the UN Regulations outline the packaging, labeling, and handling requirements for shipping dangerous goods.

The UN framework has been adopted and modified by other organizations. For example:

- The International Civil Aviation Organization (ICAO) has developed regulations for the air transport of hazardous materials. ICAO is the regulatory body for all international air shipments of dangerous goods.
- The International Air Transport Association (IATA) builds on the UN/ICAO rules and incorporates individual airline and governmental requirements into their [Dangerous Goods Regulations](#) document.
- The International Maritime Organization (IMO) is the regulatory body for all shipments of dangerous goods on the high seas.

**Where to find it**

View and order copies of the UN Model Regulations at [Unece.org/trans/danger/danger.html](https://unece.org/trans/danger/danger.html).

## REGULATORY ILLUSTRATIONS

The regulations governing the shipment of dangerous goods are vast; there is much information to absorb and apply in the 49 CFR and the UN Model Regulations. Examples showing the complexities of the rules are shown on the next page.

### **Acids by ground vs. air**

In this example, you are looking to ship one liter of Hydrazine, anhydrous. According to the MSDS, in Section 14 – Transportation, you see that this is UN2029, Packing Group I, Class 8 – Corrosive material.

If you are shipping by ground, the 49 CFR Hazardous Materials Table directs you to section 173.201. This section, which is for non-bulk packagings for liquid hazardous materials in Packing Group I, indicates that one type of acceptable outer packaging would be a fiberboard (corrugated) box – 4G. Also, the inner packaging can be made of glass, plastic, or metal, or be in a glass ampoule. There are no quantity limitations, so you could easily ship one liter or more by ground with some very basic UN packaging.

If you are shipping by air, however, it is more complex. IATA's List of Dangerous Goods indicates that this type of chemical is forbidden on Passenger Aircraft. The Cargo Aircraft Only column directs you to Packing Instruction 854, which lays out some more restrictive compatibility requirements for inner packaging such as metal containers being corrosion resistant or glass being permitted only if the substance is free of hydrofluoric acid. There are additional packaging requirements stating that inner packagings must be packed with absorbent material and placed in a rigid leak-proof receptacle before packing in outer packagings.

### **Shipping multiple quantities of 25 mL containers of gasoline**

In this example, you have multiple primary receptacles each with 25 mL of gasoline in them. You are shipping by ground. Gasoline is a Class 3 Flammable Liquid, Packing Group II material. Section 173.4 of the 49 CFR cites criteria that the material and packaging must meet. These include:

- The small quantity exception covers specific classes and divisions, Class 3 being one of them.
- The maximum quantity of material per inner receptacle is limited to 30 mL.
- The inner packaging material must be constructed of plastic with a minimum thickness of no less than 0.2 mm or be made of earthenware, glass, or metal.
- Each inner receptacle with a removable closure must have its closure held securely in place with wire, tape, or other positive means.
- Each inner receptacle or inner packaging must be surrounded with non-reactive absorbent and cushioning and securely packed in a strong outer packaging.
- This complete packaging system must be capable of sustaining five drops from 1.8 meters without breakage or leakage from any inner receptacle and without a substantial reduction in the effectiveness of the package.
- The gross mass of the completed package can't exceed 64 lbs.
- The package can't be opened or altered while in route.
- The package must be marked "This package conforms to 49 CFR 173.4 for domestic highway or rail transport only."

These examples illustrate some of the specific procedures and requirements needed to properly prepare a shipment of dangerous goods. It is the duty of the shipper to understand and comply with a wide array of regulations and standards.

## STEP-BY-STEP GUIDE

When you ship hazardous materials, are you in compliance? Here are seven steps to building a thorough program.

### Get employees trained and certified in 49 CFR

The safe handling and transport of hazardous materials begins with training. It is every Hazmat Employer's responsibility to ensure its employees are trained and tested in accordance with the requirements of 49 CFR Part 172.704. A Hazmat Employer is defined as any company that engages, on a full-time or part-time or temporary basis, Hazmat Employees who ship or cause to be shipped hazardous materials, including those who:

- load, unload, or handle hazardous materials,
- prepare hazardous materials for transportation, and/or
- operate a vehicle used to transport hazardous materials.

A Hazmat Employee also includes any person who designs, manufactures, fabricates, inspects, marks, reconditions, maintains/repairs, or tests a package or packaging component that is represented as qualified for use in transporting hazardous materials.

There are five types of training that employees must complete:

- **General Awareness/Familiarization Training** – overview of the regulations; enables the employee to recognize and identify hazardous materials consistent with the hazardous communication standards of the employer.
- **Function-Specific Training** – customized lessons specifically applicable to the functions the employee performs.
- **Safety Training** – emergency-response and self-protection measures.
- **Security Awareness Training** – awareness of security risks associated with hazardous material transportation; covers ways to enhance transportation security and recognize and respond to possible security threats.
- **In-Depth Security Training** – more detailed training regarding the company's security objectives and procedures, employee responsibilities, and actions to take in the event of a security breach.

Initial training should be completed within 90 days after beginning employment or a change in job function. Recurrent training must be completed at least once every three years. All training records must be kept by the employer, including current and preceding training, as long as that employee is employed by the company and for 90 days thereafter.

### Get Material Safety Data Sheets on all materials

Material Safety Data Sheets (MSDS) clearly outline the nature of any hazardous materials. MSDS will help you classify and communicate any hazard information properly. They will assist you with the Proper Shipping Name, Class of Hazard, and the UN Identification Number that can be cross-referenced to the Hazardous Materials Table in 49 CFR Part 172. This table indicates the information you will need to move forward in preparing your shipment.

The MSDS should be up-to-date and stored in a central location.

## Determine necessary packaging and labels

Selecting the mode of transport (air, ground, rail, and sea) is the next step. This can influence the packaging, the quantity per package, markings and labeling required, documentation, and certifications. Again, the Hazardous Materials Table, along with other sections in the 49 CFR Part 172, will provide the necessary information.

The proper package selection will include consideration of inner-packaging volume, number of inner packagings per package, cushioning and absorbents, closure and reinforcement, as well as other factors.

## Ensure the package in which you will ship has been tested and certified

After determining what package you must use, you must source this exact package. Whether working with outside suppliers or your own internal packaging team, you will need to check that the proper package is supplied, is correctly marked, and is fit for use.

## Use the package correctly when shipping

You must prepare the package in the same manner in which it was tested and certified. The package supplier is required to provide detailed assembly and closing instructions, and the package user needs to keep these instructions on file. The closing instructions should include closing torque requirements for all closure types as well as full assembly instructions. Follow these instructions perfectly and complete all necessary paperwork.

## Declare the package with the shipping carrier

It is the shipper's responsibility to declare the package as a hazardous material, or dangerous good, with the carrier. Many dangerous goods cannot be shipped with other products, so proper declarations allow the carrier to segregate freight correctly.

## Retain all shipping records

Shipping records, paper or electronic, must be retained on every shipment for two years after the material is accepted by the initial carrier. For hazardous waste, the records must be retained for three years.

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## USEFUL PARTNERS

As we have seen, the regulatory environment is comprehensive and can be complex; there are multiple steps to ensuring compliance when shipping hazardous materials.

Many companies rely on partners to assist with building and executing a dangerous goods compliance program. There are companies that specialize in training, and they will conduct seminars in central locations or even at your site with enough participants. There are testing laboratories that can check your shipping package systems against regulatory standards. And there are companies that sell packaging systems – either stock shipping systems or custom solutions that are designed and tested for specific materials and/or situations; these companies offer turnkey, reliable packaging solutions.

With the transport of dangerous goods, the cost of failure can be catastrophic. Requirements for shippers are understandably high. As such, it's important to know that there is help in the marketplace for those who are novice, for those who want to spot-check their protocols, and for those who want to augment their own capabilities with expert resources.

## SPOTLIGHT ON BERLIN PACKAGING'S DG DIVISION

Berlin Packaging is a leading supplier of rigid packaging, and its Dangerous Goods division specializes in shipping systems for the safe transport of hazardous materials as well as temperature-sensitive products.

For over 25 years, the Dangerous Goods team has been designing and assembling UN-certified packaging in a wide variety of styles. They offer a selection of over 1,500 stock packaging systems as well as the ability to custom-design solutions to meet a customer's exact needs.

Berlin Packaging has 3rd-party testing done on every offering to ensure compliance with all regulations. In addition, each package comes with all the necessary paperwork, closures, and instructions to make each offering as reliable and easy-to-use as possible.

Berlin Packaging's Dangerous Goods division has a dedicated sales force with expert knowledge of the regulations and requirements related to shipping hazardous materials.

## GETTING STARTED

Three steps will begin the journey to hazardous material shipping compliance.

First, assess the nature of the materials you are shipping. Collect Material Safety Data Sheets (MSDS) on all your materials.

Second, closely review the 49 CFR regulations (or IATA, ICAO, IMO); pay particular attention to Part 172. Cross-reference your MSDS with the Hazardous Materials Table to understand any special shipping and packaging requirements.

Third, if you are shipping materials that require performance packaging, you should create a comprehensive plan to meet all regulations. This will start with training and awareness and will also include building the proper supply chain for packaging and shipping systems.

Consulting experts in any of these three steps is a prudent way to move quickly through the process while minimizing risk.

## SUMMARY

Hazardous materials require special packaging, markings, paperwork, and placards while in transit by air, ground, rail, and sea. Specific regulations and protocols govern shipments in the United States (the 49 CFR, maintained by the U.S. Department of Transportation) and internationally (the UN Model Regulations, which have been incorporated into numerous shipping standards). It is the obligation of the shipper to know, understand, and apply these regulations on every shipment containing hazardous materials. For shippers, we reviewed seven steps that comprise a comprehensive approach to maximize safety, security, and compliance. Partners exist to help with various aspects of this approach, and companies of all sizes and sophistication often look to these experts to create, deploy, and manage their compliance programs or to supply the correct packaging containers and systems.

## ABOUT BERLIN PACKAGING

Berlin Packaging is North America's premier Hybrid Packaging Supplier of plastic, glass and metal containers and closures. With over 33,000 available SKUs, over 110 packaging consultants, and more than 80 sales and warehouse locations across North America, the company has the right products, expertise, and geographic proximity to help customers increase their net income through packaging products and services. Berlin Packaging supplies billions of containers and closures annually as well as warehousing and logistics services for customers of all sizes in all industries. It is the only company in its sector to be ISO 9001 certified, to have Customs-Trade Partnership Against Terrorism (C-TPAT) certification, and to achieve 99% on-time delivery of its shipments every month for over eight years. Related services include Studio One Eleven, a full-service custom packaging and graphic design division; Berlin Global Packaging Group, a global sourcing solutions provider including custom packaging, order and quality management, and logistics; E3, a consulting division that helps customers unlock profit; Berlin Financial Services, which provides financing for equipment and capital improvements; Dangerous Goods, offering safe, economical, UN-certified packaging solutions for shipping dangerous and temperature-sensitive goods; Freund Container & Supply, a need-it-now packaging and industrial supplies provider with no minimum order requirements; and Qorpak, a global supplier of laboratory packaging and supplies. The company can be reached at 1-800-2-BERLIN, BerlinPackaging.com, and on LinkedIn and Twitter.

## ABOUT DANGEROUS GOODS Division of Berlin Packaging

The Dangerous Goods specialty division can be reached at 1-800-413-8867, BerlinDangerousGoods.com, and DGinfo@BerlinPackaging.com.

A large, white, stylized number "11" is centered within a solid red square.