

DRY ICE SHIPPING REQUIREMENTS

2008

DEPARTMENT OF ENVIRONMENTAL
HEALTH AND SAFETY

MISSOURI UNIVERSITY OF SCIENCE &
TECHNOLOGY

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INTRODUCTION

The U.S. Department of Transportation (DOT) regulates the transportation and transport of hazardous materials in commerce. Current DOT regulations require training (and retraining) of all employees who perform work functions covered by the Hazardous Materials Regulations (49 CFR Parts 171-180). Any employee who works in a shipping, receiving or material handling area or who may be involved in preparing or transporting hazardous materials is required to have training.

The Hazardous Materials Table (49 CFR 172.101) is the backbone of the Hazardous Materials Regulations. Understanding and knowing how to use this table is the first step toward compliance. For each material listed, the Hazardous Materials Table identifies each hazard class or specifies that the material is forbidden in transportation. It provides the proper shipping name of the material or directs the user to the preferred proper shipping name. In addition, the table specifies or references requirements pertaining to labeling, packaging, quantity limits aboard aircraft, and stowage of hazardous materials aboard vessels.

It will not be necessary for Dry Ice authorized persons to actually use this table since the trained EHS Hazmat Specialist will perform all Hazardous Materials Determinations as discussed in Pre-Shipment Preparations. It **is** important that the Dry Ice authorized person be aware that their activities as shippers are regulated and that proper training is required.

Dry Ice is commonly used as a refrigerant to maintain samples in either a frozen or cold state. Dry Ice or Carbon Dioxide, Solid, is considered a hazardous material by the DOT. The transportation of Dry Ice is regulated by the DOT only when shipped by either Air or Water modes. Dry Ice is not regulated by DOT as a hazardous material when shipped by Highway mode, such as UPS Ground Service. Samples preserved with Dry Ice are almost exclusively shipped by Air mode because of the urgency of the shipment.

The following is part of the information that is listed for Dry Ice as it is shown in the Hazardous Materials Table:

Carbon dioxide, solid or Dry ice	9	UN1845	III.
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The proper shipping name is **Carbon dioxide, solid** or **Dry ice**. We will always use the second choice, Dry Ice, for shipping papers and marking. The **9** indicates that Dry Ice is a Hazard Class 9 material. Hazard Class 9 is assigned to materials which present a hazard during transportation, but which do not meet the definition of any other hazard class. In the case of Dry Ice, the carbon dioxide gas that is generated as the Dry Ice sublimates could displace oxygen in the closed environment of an airplane which could in turn cause the flight crew to lose control of the airplane. The **UN1845** is the United Nations identification number specifically for Dry Ice. In a transportation emergency this identification number can help a first responder quickly assess the type and hazards of the hazardous materials present.

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Finally, the roman numerals **III** are the Packing Group which is an indication of the relative degree of hazard for the specified Hazard Class. A Packing Group I indicates a high degree of hazard, a Packing Group II indicates a moderate degree of hazard, and a Packing Group III indicates a low degree of hazard. While Dry Ice is a Class 9 hazardous material, the DOT has determined that it poses a relatively low degree of hazard.

When Dry Ice preserved samples are shipped, the packages must be handled as restricted goods per the University's Requirement on Preparing and Shipping Packages Containing Hazardous Materials.

[Ref: Preparing and Shipping Packages Containing Hazardous Materials, available at <http://ehs.mst.edu/hazardousmaterialship/preparingshipping/prepareshipping.html>]

SECURITY AWARENESS

As a result of the terrorist attacks of September 11, 2001, and subsequent threats related to biological and chemical materials, the DOT has issued security requirements for persons who ship hazardous materials. An integral part of the DOT security requirements are transportation security plans. While Dry Ice shipments are not normally subject to these requirements, the DOT has specified that all hazmat employees receive security awareness training. The following paragraphs are based on security awareness training materials developed by the DOT and address potential targets, potential threats, and prevention.

Hazardous materials are essential for the economy of the United States and the wellbeing of its citizens. Millions of tons of hazardous materials are transported every day. They are moved by plane, train, truck, and vessel. The quantities in these shipments range from a few ounces to many thousands of gallons. In the wrong hands hazardous materials can pose a significant threat. Some of them are easily transformed into terrorist weapons. Addressing this threat is vital to protecting our citizens and our economy.

What if a cargo of chlorine gas is hijacked and released at a large public event such as a Missouri S&T football game? This unthinkable act is possible, thus the security of hazardous materials in transportation is of critical importance. While many of the materials classified by the DOT as hazardous materials are essential products for industry, they also represent potential deadly weapons in the hands of a terrorist. Some relatively simple chemical mixtures can cause a powerful explosion if detonated or ignited. The task of securing hazardous materials against unauthorized access is daunting. For example, the transportation of gasoline and propane requires a nation-wide fleet of 85,000 trucks. Law enforcement agencies alone cannot guarantee the safety of these trucks or the security of our transportation system. The

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help of everyone involved in the transportation of hazardous materials, including shippers both large and small, is needed to secure the transportation system.

A suicide bomber drives a truck loaded with ammonium nitrate, urea, and nitric acid into the garage of a high-rise office building. A terrorist cell ignites a stolen truck of gasoline in New York's Hudson River Tunnel. An anti-government militia ignites 24 million gallons of liquid propane in a storage facility. All of these scenarios are credible because they either actually happened or were planned and successfully prevented. These are just three examples of acts of violence that illustrate the vulnerability of hazardous materials in our transportation system. A terrorist or saboteur may target railroad tracks, highways, bridges, tunnels, chemical plants, population centers, or historic monuments. The fraudulent shipment of a small quantity of material by a group or individual intent on destruction is all that may be required to implement a terrorist attack. We must be aware that, regardless of how unlikely we feel that these types of events might happen, the potential threat exists.

What type of people might pose the most significant threat to transportation security? While the most likely terrorist threats are external, the unsuspected attacker could be a disgruntled employee, angry with his or her supervisor, job, or the government. He or she may often feel persecuted and sometimes make overt threats of violence. Any threat should be taken seriously. While external threats are most significant, we have learned that terrorists can be patient and may infiltrate legitimate businesses. Often they have worked for months or years in a job in order to obtain a position of trust that they can use to their advantage. Part-time and temporary employees who have access to hazardous materials may use their position to carry out acts of sabotage or theft.

What can you do to prevent or deter unauthorized access to potentially lethal hazardous materials? Start with a serious evaluation of your specific operation to identify its vulnerabilities. In matters of personnel, Missouri S&T Human Resource Services routinely screens finalists applying for positions at Missouri S&T to confirm the data provided by the applicants. Concerning hazardous materials security, you should consider keeping storage areas locked, restricting access by non-employees, and keeping updated and accurate inventories. Also consider conducting regular inspections of storage areas and conducting spot checks of personnel and vehicles.

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DRY ICE SHIPPING PROCESS

The shipping process can be broken into four stages: pre-shipment preparation, shipment preparation, shipping day, and post-shipment concerns. For most Dry Ice shipments these four stages will be completed in the course of a few hours, but in some cases they may require days or weeks. Planning is essential to the safe, effective shipment of hazardous materials.

PRE-SHIPMENT PREPARATION

The first stage of the shipping process consists of two steps: information collection and carrier selection. The information collection step consists of an investigation of the nature and composition of the sample that is being shipped. If the sample meets the definition of one or more of the DOT hazard classes or divisions, then the sample's properties will dictate which DOT regulations will apply. While the Hazardous Materials Determination is beyond the scope of the authorization for making Dry Ice shipments, a Dry Ice authorized person is responsible for the following:

- Collecting the information needed to do this determination,
- Communicating the information to EHS for consideration, and
- Complying with the decisions made by the EHS Hazmat Specialists.

The Dry Ice authorized person should either fill out a copy of the EHS Hazardous Materials Shipment Monitoring Form for Dry Ice or help the person who wants to make the shipment fill out a copy of the form. The form should then be faxed to EHS at 341-6077. An EHS Hazmat Specialist will review the form and, if necessary, will contact the person who wants to make the shipment to collect additional information about the sample. The EHS Hazmat Specialist will contact the Dry Ice authorized person with approval of the shipment as a Dry Ice only shipment. The Dry Ice authorized person should use the spaces on the form to record that approval. The Dry Ice authorized person must keep the original of the form in their records.

[Ref: EHS Hazardous Materials Shipment Monitoring Form for Dry Ice is available from EHS]

The Dry Ice authorized person will be allowed to prepare, mark, label, and offer for shipment packages in which Dry Ice is the only hazardous material present.

The second step is to contact the carrier to make arrangements for the shipment. Not all carriers will handle hazardous materials shipments. All carriers that handle hazardous materials shipments must comply with the DOT regulations. Most carriers have additional carrier-specific rules for doing business including handling hazardous materials shipments.

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For Air mode carriers the carrier-specific rules can be found in two sources: the service guide for the carrier and, for carriers who are members of the International Air Transport Association (IATA), the Dangerous Goods Regulations published by IATA (DGRs). Shippers are allowed to use the IATA DGRs in lieu of the DOT Regulations for most hazardous materials, or dangerous goods as they are called in the IATA DGRs when shipped by air. In the IATA DGRs, carrier-specific rules are called Operator Variations. In addition, the IATA DGRs contain country-specific rules for both international shipments and shipments within the United States. In the IATA DGRs, country-specific rules are called State Variations. It is the responsibility of the Dry Ice authorized person to contact EHS in advance of using an unapproved carrier in order to receive carrier-specific instructions from the EHS Hazmat Specialists. It is also the responsibility of the Dry Ice authorized person to contact EHS well in advance of each international shipment of Dry Ice in order to receive country-specific instructions from the EHS Hazmat Specialists.

The Dry Ice authorized person will be allowed to offer Dry Ice shipments only to EHS approved carriers.

The Dry Ice authorized person must have specific approval from EHS prior to each international shipment of Dry Ice.

SHIPMENT PREPARATION

The second stage of the shipping process consists of four steps: package selection, shipping paper preparation, support document preparation, and package preparation. The initial shipment preparation training will be based on the IATA DGRs and will allow the Dry Ice authorized person to use Federal Express for shipments within the United States (domestic shipments) only.

[Ref: the selected IATA DGRs cited herein are available at EHS]

The first step is the selection and inspection of a suitable packaging for the material to be shipped. All shipments containing Dry Ice as the only dangerous good will use Packing Instruction 904. The packaging selected must be designed and constructed to allow the release of carbon dioxide gas and prevent rupturing due to gas pressure build-up. The general packaging requirements of Subsection 5.0.2 must also be met. The following paragraphs are applicable to Packing Instruction 904:

- Packaging quality: 5.0.2.4 through 5.0.2.8, inclusive, and 5.0.2.10,
- Inner Packagings - Cushioning Material: 5.0.2.12.1, and
- Inner Packagings - Absorbent Material: 5.0.2.12.2.

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The use of new, unused packagings for hazardous materials shipments is highly recommended. Some packagings can be reused, such as packagings for Dry Ice shipments. If a used packaging is being reused, then it must be thoroughly inspected for both structural integrity and contamination from the previous contents. Damaged and/or contaminated packagings must not be used. Packagings that show signs of wear may not be accepted by the Air mode carrier. When in doubt about the quality of a specific packaging, contact the EHS Hazmat Specialist who approved your shipment for assistance.

Styrofoam boxes are a very common packaging for Dry Ice shipments. The Styrofoam box must be placed into an outer fiberboard box unless both of the following conditions apply:

- The Styrofoam box is actually a Styrofoam Shipper designed to be used without an outer fiberboard box **and**
- The Air mode carrier has been contacted to verify that they will handle the Styrofoam Shipper.

It is highly recommended that all Styrofoam boxes, whether designed to be used without an outer fiberboard box or not, be shipped in a sturdy, defect-free fiberboard box with a minimum 200 pound burst test rating. The outer box provides additional protection for the contents.

The second step is to prepare the shipping documentation. The documentation requirements applicable to Air mode shipments are found in Section 8. The Air Waybill and Dangerous Goods Declaration (DGD) are two separate documents that together constitute the shipping papers for an Air mode shipment. For domestic shipments containing Dry Ice as the only dangerous good, only the Air Waybill is required. The DGD is not required. The Air Waybill is discussed in Subsection 8.2.

When using Federal Express for domestic shipments, the domestic FedEx Air Waybill must be used. When using Federal Express for international shipments, an international FedEx Air Waybill must be used. These forms have a special handling box just for Dry Ice that when properly completed provides compliance with the IATA DGRs. Since the IATA DGRs do change with time, the Dry Ice authorized person must make sure that the most up to date version of the FedEx Air Waybill is being used. Contact Federal Express to obtain a supply of the current Air Waybills and discard all outdated versions.

[Ref: a FedEx Air Waybill instructional example is available from EHS]

The third step is to prepare the support documents. These are documents that must be supplied in addition to the Air Waybill. These are not covered in the IATA DGRs.

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International shipments will require such support documents. One or more of the following additional documents will apply to an international shipment:

- Commercial Invoice,
- Shipper's Export Declaration,
- Export Permit or Authorization, and/or
- Import Permit or Authorization.

The specific documents needed for a specific international shipment will be determined by the EHS Hazmat Specialist who is assisting the Dry Ice authorized person.

The Dry Ice authorized person must have specific approval from EHS prior to each international shipment of Dry Ice.

The fourth step is to prepare the package for shipment. This step consists of two parts: assembly of the package and marking/labeling of the package. The empty packaging when properly filled is called a package. As specified in Packing Instruction 904, the packaging selected must be designed and constructed to allow the release of carbon dioxide gas and prevent rupturing due to gas pressure build-up. Furthermore, the sealing of the package must not interfere with this gas release feature. Place tape only as directed by either the packaging manufacturer's instructions or where it will not interfere with gas release.

It is highly recommended that all Styrofoam boxes, whether designed to be used without an outer fiberboard box or not, be shipped in a sturdy, defect-free fiberboard box with a minimum 200 pound burst test rating. The outer box provides additional protection for the contents. It also provides a surface to which the necessary self-adhesive labels will better stick.

Dry Ice is a cryogenic solid with a surface temperature of -109.3°F or -78.5°C and is capable of producing severe frostbite on prolonged exposure. Always handle Dry Ice with care and wear protective cloth or leather gloves whenever touching it. An oven mitt or towel will work. If touched briefly it is harmless, but prolonged contact with the skin will freeze cells and cause injury similar to a burn. Treat Dry Ice burns the same as regular heat burns. See a doctor if the skin blisters or comes off. Otherwise, if only red, it will heal in time as any other burn. Apply antibiotic ointment to prevent infection and bandage only if the burned skin area needs to be protected.

Normal air is 78% Nitrogen, 21% Oxygen and only 0.035% Carbon Dioxide. If the concentration of carbon dioxide in the air rises above 0.5%, carbon dioxide can become dangerous. Smaller concentrations can cause quicker breathing but is otherwise not harmful. If Dry Ice has been in a closed auto, van, room, or walk-in, for more than 10 minutes, open doors and allow adequate ventilation before entering. Leave the area containing Dry Ice if you start to pant and breathe quickly or your fingernails or lips start to turn blue. This is the

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sign that you have breathed in too much CO₂ and not enough oxygen. Dry Ice CO₂ is heavier than air and will accumulate in low spaces. Do not enter closed storage areas that have or have had Dry Ice before airing out completely.

If Dry Ice is spilled, it should be swept up immediately to prevent a slipping hazard. Unwanted Dry Ice should be left at room temperature in a well-ventilated area.

Packing Instruction 904 specifies that the outside of the package be marked with the net weight of Dry Ice contained in the package. This weight must be given in units of kilograms in order to be accepted by Federal Express and other IATA member Air mode carriers. Additional marking and labeling requirements are found in Section 7. The following marking requirements apply to all shipments containing Dry Ice as the only dangerous good:

- 7.1.5.1 (a): Proper Shipping Name and UN Number,
 (b): Name and Address of shipper and consignee, and
 (c): Net Weight of Dry Ice (as stated in Pkg. Instr. 904).

The labeling requirement is to affix a Class 9 - Miscellaneous Dangerous Goods Hazard Label as shown in Subsection 7.3.18. EHS requires the use of Labelmaster's (1-800-621-5808) HML-DI Dry Ice Label, which includes a properly designed Class 9 label. The shipper's specific responsibilities found in both Paragraph 7.1.1 for marking and Paragraph 7.2.1 for labeling, must be carefully considered.

The shipment preparations are now complete. It is highly recommended that the IATA Acceptance Check List for Dry Ice as well as this document be used to verify that all of the applicable requirements have been addressed.

[Ref: the IATA Acceptance Check List for Dry Ice is available from EHS]

SHIPPING DAY

The third stage of the shipping process is to call the selected Air mode carrier and arrange for the pick up of the package. When the representative of the Air mode carrier arrives, they will quickly review the documentation being supplied and the package being offered. Based on that review they will:

- Accept the package as it has been offered,
- Make acceptance of the package contingent on alterations in the documentation and/or the package sealing, marking, and/or labeling, or
- Reject the package.

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Before making any alterations to the documentation and/or the package, the Dry Ice authorized person must verify that such changes are not in contradiction with the IATA DGRs as well as this document. Alterations that would result in non-compliance cannot be made. If the concerns expressed by the representative of the Air mode carrier cannot be addressed by the Dry Ice authorized person in a manner that assures compliance, then the package must not be shipped.

Dangerous Goods packages cannot, under any circumstance, be delivered to the Air mode carrier. All Dangerous Good packages must be picked up at an Missouri S&T location by the Air mode carrier.

The Dry Ice authorized person must contact an EHS Hazmat Specialist for evaluation of any unresolved conflicts with an Air mode carrier prior to either re-offering the package or offering the package to a different approved Air mode carrier.

POST-SHIPMENT CONCERNS

The fourth stage of the shipping process involves recordkeeping. The Dry Ice authorized person must maintain a record of the following for each Dry Ice shipment that they prepare:

- The pre-shipment information collected,
- The result of the Hazardous Materials Determination decision made by the EHS Hazmat Specialist, and
- A copy of the shipping document and support documents provided to the Air mode carrier.

The record system can be of any functional design, but a manual paper system would be preferred. This record system must be kept up to date and available for inspection by EHS and DOT. The EHS Hazardous Materials Shipment Monitoring Form for Dry Ice provides spaces to record the information collected and the result of the EHS Hazmat Specialist's decision. The Dry Ice authorized person must mail a copy of the Air Waybill to the EHS Hazmat Specialist who assisted them. The copy of the Air Waybill must be mailed on or before the day that the package is being picked up by the Air mode carrier.

A copy of the Air Waybill must be sent to EHS on or before the day that the Air mode carrier actually picks up the Dry Ice Package.

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