Shipping Non-Infectious Specimens and Dry Ice

This module applies to personnel shipping:

• specimens that can be reasonably assumed not to harbor infectious agents.
• dry ice.

This module is comprised of 4 parts (37 slides) and should take approximately 40 minutes to review.

A downloadable copy of this presentation is available at [www.musc.edu/biosafety/Shipping](http://www.musc.edu/biosafety/Shipping).
Part I: Dangerous Goods Overview
Why is this training necessary?

The federal government requires training and certification prior to shipping or transporting hazardous materials. This presentation provides the necessary training and certification, which must be renewed every 24 months.

- Agencies providing applicable regulations and guidelines include:
  - IATA – International Air Transport Association
  - ICAO – International Civil Aviation Organization
  - DOT – U.S. Department of Transportation

Penalties for non-compliance with shipping regulations can result in the following fines:

- Up to $250,000 and up to a year jail sentence for individuals
- Up to $500,000 per incident for organizations
What are dangerous goods?

- A **dangerous good** is any article or substance capable of posing a risk to health, safety, property, or the environment. (IATA)

- A material or substance posing an unreasonable risk to health, safety, and property when transported. (DOT)

- An equivalent term is **hazardous material**, or hazmat.
What are the shipping regulations?

• By law, anyone who packs, ships, transports or receives dangerous goods must be trained to properly:
  – Identify and classify dangerous goods
  – Package dangerous goods
  – Label and mark packages
  – Document shipments

The shipper bares ultimate legal responsibility and liability for properly performing these tasks.
1) **Classification**: The material being shipped must be categorized as a type of hazardous material.

2) **Identification**: The shipper selects the proper shipping information from the IATA Dangerous Goods Regulations.

3) **Packaging**: Properly packing the hazardous material for shipment.

4) **Marking**: Writing the following on the package: addresses, shipping name of hazardous material and UN code.

5) **Labeling**: Identify the package as possessing a hazardous material and give a general indication of the type of material.

6) **Documenting**: Filling in and signing the airway bill. Maintaining records of shipments for two years following the shipment.
Part II: Proper Classification and Identification of Specimens and Dry Ice
Hazard Classes

- There are nine hazard classes—two are often used by laboratories:

  Class 1: Explosives
  Class 2: Gases
  Class 3: Flammable Liquids
  Class 4: Flammable Solids
  Class 5: Oxidizers and Organic Peroxides
  Class 6: Toxic (poisonous) and Infectious Substances
    - 6.1 Toxic Substances
    - 6.2 Infectious Substances
  Class 7: Radioactive
  Class 8: Corrosive
  Class 9: Miscellaneous Dangerous Goods (includes dry ice)
2) Identification: The shipper selects the proper shipping information from the International Air Transport Association’s Dangerous Goods Regulations (IATA DGR).

The IATA DGR is recognized by the world’s airlines as the accepted guide for shipping hazardous material.

The IATA DGR provides:

• The proper shipping name
• The UN number specific to each type of dangerous good
• Packing Instructions
• Quantity limits for packages
• Quantity limits for varying types of aircraft
<table>
<thead>
<tr>
<th>Shipment Type</th>
<th>Proper Shipping Name</th>
<th>UN Number</th>
<th>Hazard Class</th>
<th>Packing Group</th>
<th>Packing Instruction (PI)</th>
<th>Max. Qty. per primary package</th>
<th>Max. Net Qty/Pkg. for passenger aircraft</th>
<th>Max. Net Qty/Pkg. for cargo aircraft</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Category A:</strong> Infectious substance, affecting humans and possibly animals</td>
<td>Infectious Substance, Affecting Humans</td>
<td>UN2814</td>
<td>6.2</td>
<td></td>
<td>620</td>
<td>Liquids: 4 L Solids: 4 Kg</td>
<td>50 mL or 50 g</td>
<td>4 L or 4 Kg</td>
</tr>
<tr>
<td><strong>Category A:</strong> Infectious substance, affecting only animals</td>
<td>Infectious Substance, Affecting Animals</td>
<td>UN2900</td>
<td>6.2</td>
<td></td>
<td>620</td>
<td>Liquids: 4 L Solids: 4 Kg</td>
<td>50 mL or 50 g</td>
<td>4 L or 4 Kg</td>
</tr>
<tr>
<td><strong>Category B:</strong> Infectious Substance</td>
<td>Biological Substance, Category B</td>
<td>UN3373</td>
<td>6.2</td>
<td></td>
<td>650</td>
<td>Liquids: 1 L Solids: 4 Kg</td>
<td>4 L or 4 Kg</td>
<td>4 L or 4 Kg</td>
</tr>
<tr>
<td>Diagnostic or Clinical Specimens (non-infectious)</td>
<td>Exempt human specimen, Exempt Animal Specimen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dried blood spots</td>
<td>Not Regulated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry Ice</td>
<td>Dry Ice Or Carbon Dioxide, solid</td>
<td>UN1845</td>
<td>9</td>
<td>III</td>
<td>904</td>
<td>No Limit</td>
<td>200 Kg</td>
<td>200 Kg</td>
</tr>
</tbody>
</table>
INFECTIONOUS SUBSTANCES are class 6.2 Dangerous Goods.

Infectious substances are known or reasonably expected to contain pathogens. Pathogens are defined as microorganisms (including bacteria, viruses, rickettsiae, parasites, or fungi) or other agents such as prions, which have the potential to cause transmissible diseases.

Two major classifications exist for shipping infectious substances:

- **Category A** infectious agents capable of causing permanent disability, life threatening or fatal disease in humans or animals.

- **Category B** infectious agents that do not pose a risk of causing permanent disability, life threatening or fatal disease to humans or animals.

More information will be provided in the training module for shipping infectious agents.
**Exempt Human/Animal Specimens**

Definition: Human or animal material which do not contain infectious substances or substances which are unlikely to cause disease in humans or animals and are transported for diagnostic or investigational purposes.

Includes the following:

- Excreta (urine, feces)
- Secreta (saliva, sweat)
- Blood or its components
- Tissues and Fluids

**Example:** Routine blood, serum or urine samples from patients shipped to a laboratory for routine testing are exempt only if...

in your professional judgment (based on medical history, symptoms and individual circumstances of the source) the patients have a minimal likelihood of being infectious.

Specimens suspected of being infectious should be shipped as infectious agents.

Live animals or infected animal specimens are not considered exempt.
Other Exempt Biological Specimens

**Neutralized or inactivated biological substance:**
Substances in a form that any present pathogens have been neutralized or inactivated such that they no longer pose a health risk.

**Microorganisms** which are non-pathogenic to humans or animals and do not pose a threat to the environment.
NOTE: genetically modified organisms are not exempt and should be shipped as a class 9 miscellaneous hazards.

**Environmental Samples** (including food and water samples), which are not considered to pose a significant risk of infection.

**Dried blood spots:**
Collected by applying a drop of blood on to absorbent material or fecal occult blood screening tests.

**Transfusion materials:**
(Uninfected) Blood components which have been collected for the purposes of transfusion or the preparation of blood products to be used for transfusion or transplantation.
Packing Groups

• Packing groups indicate the relative degree of danger the substance presents:
  – Packing Group I – Great Danger
  – Packing Group II – Medium Danger
  – Packing Group III – Minor Danger

• Infectious and biological specimens are not assigned to a packing group

• Dry ice is assigned to Packing Group III
Part III: Proper Packaging of Specimens
Selecting the Proper Packaging

Federal regulations state that packaging used to ship hazardous materials must be tested and certified as capable of performing up to regulatory standards for ability to withstand:

- Vibrations,
- Drops,
- Pressure,
- Stacking,
- Rainfall,
- Puncture,
- Leaks,
- Etc.

It's highly recommended to purchase packaging specifically designed for shipping the intended hazardous material.

Diligence in selecting the proper packaging will safeguard your shipment, and reduce your liability in case of a shipping accident.
Commercial Vendors of Packaging for Shipping Dry Ice

Air Sea Atlanta
1234 Logan Circle
Atlanta, GA 30318
(880) 351-8600
http://www.airseaatlanta.com

DG Supplies, Inc.
5 Boxal Drive
Cranbury, NJ 08512
(800) 347-7879
http://www.dgsupplies.com

Polyfoam Packers Corporation
2320 S. Foster Avenue
Wheeling, IL 60090
(888) 765-9362
http://www.polyfoam.com

All-Pak, Inc.
Corporate One West
1195 Washington Pike
Bridgeville, PA 15017
(800) 245-2283
http://www.all-pak.com

HAZMATPAC, Inc.
5301 Polk St., Bldg. 18
Houston, TX 77023
(800) 923-9123
http://www.hazmatpac.com

SAF-T-PAK, Inc.
10807-182 Street, Edmonton
Alberta, Canada, T5S 1J5
(800) 814-7484
http://www.saftpak.com

CARGOpak Corporation
3215-A Wellington Court
Raleigh, NC 27615
(800) 266-0652
http://www.cargopak.com

Inmark, Inc.
220 Fisk Drive S.W.
Atlanta, GA 30336-0309
(800) 646-6275
http://www.inmarkinc.com

Source Packaging
of New England, Inc.
405 Kilvert Street
Warwick, RI 02886
(800) 200-0366
http://www.sourcepak.com
The three elements of triple packaging system for shipping biological materials include:

1) a primary watertight receptacle (Eppendorf tube, conical or vial)
2) a leak-proof secondary container (in case primary containment fails)
3) a durable outer container (box/packaging)
The hazardous material to be shipped shall be placed in a securely closed, watertight, **leakproof, primary container with labeled contents**. The container must be secured by positive means. For example, parafilm can be used to secure the seal of specimen tubes and specimen bags can be taped shut.

**Sufficient absorbent material** should be included within the secondary container to completely absorb the contents in case of a spill. Several **primary** containers can be placed in a durable, watertight container that acts as a **secondary** container.

An **itemized list of contents** should be placed between the secondary container and the outer package.

The **primary** and **secondary** containers should then be placed in an **outer shipping** container constructed of fiberboard that protects the contents from physical damage during transport.
An overpack can be used to combine several small packages of infectious materials into a larger package.

All inner packages must be correctly packed, marked and labeled. Individual inner packages must not exceed quantity limits found in the IATA DGR.

The overpack must bear all the applicable markings for shipment of its contents.

In addition, the overpack must bear the statement: “OVERPACK.”

The volume of infectious agent is the total net volume of all the inner packages.
human or animal materials being transported for diagnostic or investigational purposes that are not believed to harbor infectious agents are exempt from dangerous goods regulations. If there is more than a minimal likelihood that a specimen is infectious, it should be shipped as an infectious agent.

Specimens should be shipped using the triple packaging system.

The outer package must be durable enough for its intended use with at least one side measuring 100 x 100 mm (~4 inches squared)

The outer package must be marked with “Exempt human specimen” or “Exempt animal specimen”.
Hazards of Shipping Dry Ice

Dry ice is considered hazardous during transport for three reasons:

**Explosion hazard:** dry ice releases a large volume of carbon dioxide gas as it sublimates. If packaged in a container that does not allow for release of the gas, the package may explode, causing personal injury or property damage.

**Suffocation hazard:** a large volume of carbon dioxide gas emitted in a confined or poorly ventilated space may create an oxygen deficient atmosphere.

**Contact hazard:** dry ice is a cryogenic material that causes severe frostbite upon contact with skin.
Five Requirements for Packages Containing Dry Ice

1) **Gas venting**: packages must allow for release of carbon dioxide gas. Dry ice must never be sealed in a container with an airtight seal.

2) **Package integrity**: a package containing dry ice must be of adequate strength to:

   - Withstand the loading and unloading normally encountered in transport.
   - Prevent any loss of contents that might be caused by vibration or by changes in temperature, humidity, or altitude.

3) **Package materials**: do not use plastics that can be rendered brittle or permeable by the temperature of dry ice. This problem can be avoided by using commercially available packages intended to contain dry ice.
Five Requirements for Packages Containing Dry Ice

4) Marking the Airbill: the airbill (or air waybill) must include the statement:

“Dry ice, 9, UN1845, number of packages X net weight in kilograms.”

FedEx has a check box on their airbill to satisfy this requirement. For example, the highlighted area documents 1 box containing 6 kg of dry ice.
Five Requirements for Packages Containing Dry Ice

4) Marking the Airbill: the airbill (or air waybill) must include the statement:

“Dry ice, 9, UN1845, number of packages X net weight in kilograms.”

Airborne Express requires a slightly different format from FedEx. The highlighted area shows format required for 1 box containing 5 kg of dry ice.
Five Requirements for Packages Containing Dry Ice

5) Labeling: the outermost container must be labeled with:

- hazard class 9 label (Shown bellow)
- UN 1845, Dry Ice
- net weight of dry ice in kilograms

The dry ice shipping label should be affixed to a vertical side of the box (not the top or bottom) and oriented as shown bellow. The maximum allowable net quantity of dry ice allowed per package is 200 kg.

When calculating weight, assume: 1 lb. = 0.5 Kg
Recommendations

• Pack dry ice on top of specimens.

• Fragile containers such as glass tubes or vials should be wrapped with cushioning material.

• Minimize the volume of air to which the dry ice is exposed in order to slow the rate of sublimation. If there is any air space after you fill your package with dry ice, fill it with packing peanuts or other material to reduce the volume of air space.

• Shipments are generally recommended to contain 5-10 pounds (2.27-4.54 kg) of dry ice per 24 hours.

• Plan accordingly to ensure your package will be received on its intended delivery date. Take into account weekends and local holidays that might delay package receipt.

• Secure your samples in such a way that when the dry ice sublimates, they will not move freely inside of the insulated box. This can be accomplished by wedging your samples in place with cardboard or styrofoam.
Recommendations (Continued…)

• Dry ice shipments can be made with FedEx and DHL.

• UPS and the U.S. Postal Service have extremely restrictive policies concerning shipments of hazardous materials; do not ship dry ice with UPS or the U.S. Postal Service.

• Packages refrigerated with dry ice are normally shipped by air in order to reach their destinations rapidly.

• If you choose to reuse a dry ice box, completely obliterate all unnecessary marking such as hazard labels, addresses, FedEx (or other courier) labels and barcodes.

• Use caution if reusing a box that has been used to ship infectious material or diagnostic specimens. Only reuse a box if you can personally verify it is not contaminated and its integrity is intact. A box should not be reused if it is torn, cut, stained, or if the insulation is cracked or broken.
Shipping Fixed / Preserved Specimens

Solutions used to preserve biological specimens may be regulated as dangerous goods.

See the list of commonly used fixatives below to determine if your fixative is regulated. 
**NOTE: <10% Formalin is NOT regulated.**

Shipments of fixed specimens tend to utilize small quantities of fixatives and may be classified as "dangerous goods in excepted quantities“ as long as they meet the quantity restrictions for primary (e.g. individual vial) and outer packages (complete shipment).

<table>
<thead>
<tr>
<th>Shipment Type</th>
<th>Proper Shipping Name</th>
<th>UN Number</th>
<th>Hazard Class</th>
<th>Packing Group</th>
<th>Packing Instruction (PI)</th>
<th>Max. Quantity per primary package</th>
<th>Max. Quantity per outer package</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 10% Formalin (contains &lt; 3.7% formaldehyde)</td>
<td>NOT REGULATED. 10% Formalin (contains 3.7% formaldehyde)</td>
<td>UN 2209</td>
<td>8</td>
<td>II</td>
<td>852</td>
<td>30 mL</td>
<td>500 mL</td>
</tr>
<tr>
<td>Formaldehyde ( ≥ 25%) and Undiluted Formalin (containing 37% formaldehyde)</td>
<td>Formaldehyde solution with not less than 25% formaldehyde</td>
<td>UN 2209</td>
<td>8</td>
<td>II</td>
<td>852</td>
<td>30 mL</td>
<td>500 mL</td>
</tr>
<tr>
<td>Paraformaldehyde</td>
<td>Classify similarly to formaldehyde. Refer to above based on concentration of paraformaldehyde solution.</td>
<td>UN 2209</td>
<td>8</td>
<td>II</td>
<td>852</td>
<td>30 mL</td>
<td>500 mL</td>
</tr>
<tr>
<td>Ethanol ( &gt; 24%)</td>
<td>Ethanol</td>
<td>UN 1170</td>
<td>3</td>
<td>III</td>
<td>Y344</td>
<td>30 mL</td>
<td>1L</td>
</tr>
</tbody>
</table>
Shipping Fixed / Preserved Specimens

Shipments containing REGULATED fixatives in excepted quantities require the label shown below. For example, if shipping specimens fixed in 95% ethanol to the CDC.

Ethanol Hazard Class: 3

Send to:
John Doe
CDC
Atlanta, GA

The label must be printed in color and displayed on the outer package.

The dangerous goods in excepted quantities label can be downloaded from: www.musc.edu/biosafety/excepted.pdf
Part IV: Documentation and Training Associated with Shipments
• Personnel should maintain records of shipping training for two years.

• Training must be renewed every 24 months.

• Filling in and signing a shipment’s airway bill provides documentation of the shipment.

• Records of shipments should be maintained for two years following the shipment.
Emergency Measures

- Take measures to protect yourself and your employees who ship dangerous goods:
  - Participate and maintain records of training such as:
    - General Lab Safety
    - Blood Borne Pathogen
    - Employee Right to Know
  - Always wear gloves and protective clothing
  - Consider opening packages containing infectious agents in biosafety cabinets
  - Treat all spills as if they are infectious
General Security Guidelines

- General industry guidelines for the security of dangerous goods:
  - Keep storage areas locked
  - Keep updated and accurate inventories
  - Conduct regular inspections of storage areas
  - Conduct security spot checks of personnel and vehicles
  - Lock all equipment
  - Restrict access of non-employees
Obtaining Certification

You will soon be administered a quiz on the material contained in this module.

Personnel must obtain a score of at least 85% or 13 of 15 questions correct to pass.

Individuals who fail should retake the quiz until passing.

CATTS will generate a certificate of training upon passing the quiz.

Please PRINT the Certificate and keep for two years as your record of training.

Please remember to retake the training within 24 months to keep your training current.

If required to ship infectious agents, please take the infectious agent shipping module.
CATTS has experienced compatibility issues with newer versions of Internet Explorer leading to trouble printing certificates.

If the printing option is not available:
Maximize the window
Right click on the grey background to open a windows dropdown menu
Click on “Print”

If the problem persists, contact:
Daniel Eisenman, PhD
Tel. 792-4304
eisenman@musc.edu
Questions or Emergencies Contact:

Daniel Eisenman, Ph.D.
Biosafety Officer
Phone: (843) 792-4304
Fax: (843) 792-0284
Pager: (843) 792-0590/12883
email: eisenman@musc.edu

A downloadable copy of this presentation is available at www.musc.edu/biosafety/Shipping.

Certain materials included in this presentation were adapted from the following sources with permission:
University of New Hampshire Guides for Shipping Dry Ice, Formaldehyde and Biological Materials, By Andy Glode and David R. Gillum
The MAYO Clinic Laboratories Guide to Transporting Dangerous Goods, By Terry Severson and Michelle E. Buri