



Conserve O Gram

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Shipping and Handling of Natural History Wet Specimens Stored in Fluids as “Dangerous Goods” – Hazardous Materials

Natural history specimens may be stored in flammable or hazardous fluids such as ethanol, isopropanol or formaldehyde, in varying concentrations. Their shipment is governed by Dangerous Goods Regulations.

This NPS *Conserve-O-Gram* (COG) complements COGs 2/18, Safe Storage and Handling of Natural History Specimens Preserved in Fluid, 2/20, Handling and Shipping Cellulose Nitrate Film. See also 17/2, Packing Museum Objects for Shipment and 17/3, Crating Museum Objects for Shipment. NPS *Museum Handbook* Part I, Chapter 6 Handling, Packing and Shipping.

Most natural history specimen shipments are sent by airmail to minimize the time specimens are exposed to transport hazards and to reduce chances of damage and dehydration.

Shipping dangerous goods by air presents particular problems. Domestic shipments must comply with the International Civil Aviation Organization (ICAO) and the US Department of Transportation (DOT) standard aircraft shipping and packaging regulations.

Shipments sent through the mail within the US must also conform to United States Postal Service (USPS) regulations. Courier shipments Federal Express (FedEx), United Parcel Service) UPS and DHL International Ltd. (DHL) must conform to the individual company's

specific regulations (which for the most part follow IATA regulations). USPS and private courier regulations must meet or exceed the DOT regulations respectively; in many instances they are more restrictive

Dangerous Goods/Hazardous Materials

Dangerous goods/hazardous materials are classified according to Hazard Class and Packing Group. Most flammable liquids fall into Hazard Class 3. Within each Hazard Class, materials are classified into three Packing Groups.

Of the substances most commonly used in wet collections only ethanol, isopropanol and formaldehyde are covered under dangerous goods regulations. If specimens are stored in another fluid, be sure to determine if that fluid is covered by dangerous goods regulations.

Ethanol (ethyl alcohol), most commonly used in concentrations of 70% and above, is regulated for transport. Concentrations between 10% and 80% fall into Packing Group III while concentrations above this fall into Packing Group II. Specimens preserved specifically for DNA study are stored in 95% alcohol.

Isopropanol (isopropyl alcohol), most commonly used at concentrations of 50% and above, falls into Packing Group III at concentrations of

10 to 30% while concentrations above this fall into Packing Group II.

Formaldehyde (formalin) in concentrations above 10% is a Class 9, packing group III substance and is regulated for transport. What is called “10% formalin” in natural history collections is, in fact, 3.7% or 4.0% formaldehyde (formaldehyde is a saturated solution of formaldehyde gas in water, measured by weight or volume concentration) and as such is unregulated for transport.

Glycerin (glycerol) used for cleared and stained specimens, is not regulated in any concentration.

The shipment of infectious substances, natural history specimens not containing dangerous goods (pinned insects, skins, skeletons etc.), biological materials other than natural history specimens and any material on dry ice is covered by a separate set of regulations. (49 CFR 173.217). There may also be ancillary permitting requirements for the domestic or international transfer of biological specimens (US Fish and Wildlife, APHIS, CITES, etc.). Each shipment must have all required permits.

Training

All individuals who pack, handle or ship dangerous goods **must be appropriately trained**. Training can be obtained from commercial companies that specialize in dangerous goods or hazardous materials training. Times and costs vary. For quantities above restricted quantities, more extensive training is required.

Regulations

Shipping and packing guidelines include special dispensations for **smaller** quantities of danger-

ous goods. The small quantity regulations have a number of limitations that must be adhered to. Consult the DOT regulations before shipping. USPS and DOT regulations are available online^{1,2}.

The shipment of dangerous goods (referred to as hazardous materials) is covered in DOT Title 49 CFR¹ (Parts 100 to 185) and USPS Publication 52².

Exceptions for Small Quantities

An exception to the regulations is made for dangerous goods in restricted quantities “termed small quantity regulations” outlined in DOT 173.4 and USPS Publication 52 (334). These small quantities are considered exempt from regular DOT and USPS hazardous goods requirements. Most fluid preserved natural history specimens can be packed and shipped using these small quantity regulations.

1. Small quantities may be sent through the USPS via air transportation (express, priority and first-class mail) or surface transportation as standard or parcel post, or by any of the three major courier companies (FedEx, UPS and DHL) that follow DOT 49 CFR 173.4 small quantity regulations. Class 3 dangerous goods (all packing groups) are acceptable (ethanol and isopropanol).
2. The maximum quantity of dangerous goods per inner receptacle **cannot exceed 30 ml** for acceptable liquids (as above). This inner receptacle cannot be liquid full at 55°C (131°F) and is to be constructed of plastic (having a minimum thickness of 0.2mm) earthenware, glass, or metal.
3. A removable closure on an inner receptacle must be held securely in place using wire, tape

or other means.

4. Each inner receptacle must be placed within a securely sealed secondary package.

5. Sufficient cushioning and absorbent material (that will not react chemically with the dangerous goods) must surround each inner receptacle and be capable of absorbing the entire contents of the receptacle.

6. The secondary packages must be securely packed in a strong outer package (box) that complies with DOT mandated drop and compressive load tests without breakage or leakage from any internal receptacle.

7. Packages must pass the drop tests – a free drop on top, bottom, long and short side and the junction of three sides of the package from 1.8m (5.9 feet) onto a solid unyielding surface, with no damage to the containers inside.

8. Packages must pass the compressive load test, by withstanding the weight of a stack packages of similar size and weight to a height of no less than 3m (10 feet) for 24 hours.

9. Packages can not exceed 29 kg (64 pounds).

10. The address side of each package must be clearly marked with “This package conforms to 49 CFR 173.4” and complete return address and delivery address must be furnished. There are no other labeling requirements.

Wet Natural History Specimens Not Shipped in Fluids

The common practice of wrapping specimens normally stored in fluids in cheese cloth or gauze moistened with alcohol and sealed in plastic will keep the material from being con-

sidered dangerous goods as long as no more than 30 ml of 70% ethanol was used in each individual package and the heat sealed plastic bags are at least 0.2mm thick. Specimens preserved in 3.7% formaldehyde can be shipped in regular mail both domestically and internationally without any dangerous goods requirements.

Tissue samples can be placed in cryovials or glass vials in less than 30 ml of 99% ethanol if the caps are secured with tape or Parafilm, and the vials placed in a secondary heat sealed plastic bag with absorbent material and packed similar to the above.

At this time, Dangerous Goods Regulations do not specifically address the shipment of natural history specimens. Various scientific groups are working with governmental organizations to remedy shortcomings of the existing regulations for natural history specimen shipments.

References

- 1 Title 49 CFR, Subtitle B, Chapter 1, Subchapter C: Hazardous materials regulations. US Department of Transportation (DOT). http://www.access.gpo.gov/nara/cfr/waisidx_99/49cfrv2_99.html
- 2 USPS Publication 52: Hazardous, Restricted, and Perishable Mail. Part 3: Hazardous Materials. Pgs 15-60. July 1999. <http://www.usps.com/cpim/ftp/pubs/pub52.pdf>
- 3 IATA Dangerous Goods Regulations, Section 2 - Limitations pages 9-80. International Air Transport Association. 48th Edition. 2007. Not online.
- 4 FedEx Dangerous goods shipping website:

<http://www.FedEx.com/us/services/options/express/dangerousgoods/hidden.html>

FedEx Dangerous Goods/Hazardous Materials Hotline: 1-800-463-3339.

- 5 UPS dangerous goods shipping website:
<http://www.ups.com/content/us/en/resources/prepare/idg/information/definition.html>
UPS Hazardous Materials Support Center:
1-800-554-9964.
- 6 DHL dangerous goods shipping website:
<http://www.dhl-usa.com/usgov/servopt>
DHL Hazardous Materials Hotline: 1-866-588-2002.

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