



WORKING PAPER

**DANGEROUS GOODS PANEL (DGP)
MEETING OF THE WORKING GROUP OF THE WHOLE**

Auckland, New Zealand, 4 to 8 May 2009

Agenda Item 2: Development of recommendations for amendments to the *Technical Instructions for the Safe Transport of Dangerous Goods by Air* (Doc 9284) for incorporation in the 2011/2012 Edition

2.3: Part 3 — Dangerous Goods List, Special Provisions and Limited and Excepted Quantities

TRANSPORT OF MUSEUM SPECIMENS

(Presented by D. Brennan)

SUMMARY

This working paper proposes that a special provision be added to Part 3;4 of the *Technical Instructions for the Safe Transport of Dangerous Goods by Air* (Doc 9284), to allow museums to ship specimens that are packed with very small quantities of ethanol, denatured ethanol, isopropanol or formaldehyde.

Action by the DGP-WG is in paragraph 2.

1. INTRODUCTION

1.1 This working paper was developed on behalf of two organizations whose members include natural history museums and collections worldwide (The Society for the Preservation of Natural History Collections (SPNHC) and the Natural Science Collections Alliance (NSCA)) that have been tasked with attempting to resolve issues involving shipping specimens both domestically and internationally between museums and individual researchers studying the life of the planet as it pertains to biodiversity, ecology, genetics, conservation, evolution, and virtually any other aspect of natural history.

1.2 Recently the Biodiversity Research Center of the University of Kansas convened a roundtable at the Society for the Preservation of Natural History Collections (SPNHC) conference in Oklahoma City, which was attended by IATA together with representatives of FedEx, UPS and DOT. Emanating from this was a letter of interpretation from DOT for domestic shipping together with a similar letter from USPS which will allow domestic shipments of specimens to be shipped using USPS when adhering to DOT 49 CFR 173.4 packaging requirements. Both of these letters are attached to this working

paper and hopefully will serve as a model for similar exceptions being inserted into the Technical Instructions.

1.3 Museums worldwide maintain collections of billions of specimens of mammals, birds, fishes, insects and other invertebrates, and amphibians and reptiles (estimated at 3.5 billion and growing). There are an estimated 6 500 museums worldwide, of which 1 200 are in the United States. A large majority of these museums contain multiple collections that ship specimens in dangerous goods. Our collections exist, in part, to give the scientific community an opportunity to study specimens collected decades (or even centuries) ago through today, to answer questions about biodiversity, ecology, genetics, conservation, evolution, and virtually all other aspects of natural history. These collections are not unlike libraries, with a wealth of information associated with each and every specimen. While many of our specimens are “dry” (skeletons, skins, pinned insects), a significant number are stored or transported moistened in a 70% ethanol solution (“fluid-preserved” specimens), a standard practice in natural history museums worldwide. Still others (or parts thereof) are stored or transported wet in 3.7% formaldehyde solution and 95% ethanol for genetic or DNA extraction purposes.

1.4 Just as libraries loan out their books, museums loan our specimens to researchers all over the world. A recent survey of our membership asked the following questions – data for the last five years (average) was requested:

- 1) How many international packages do you send that contain specimens in dangerous goods?
- 2) How many specimens are contained in these packages?
- 3) What methods do you use to package these materials?
- 4) What method of shipment do you use?
- 5) Which countries do you send and receive material from?
- 6) Are your shipping practices being hindered by budgetary restrictions?
- 7) Is your shipping to any countries being hindered by dangerous goods regulations?

42 collections responded (mainly from the US but also Canada, the UK and Germany) and the following information was collated.

1.5 2 071 packages, containing 95 455 specimens (very large numbers of insects etc. are sent per package) were sent on a yearly basis. Of these the vast majority were specimens in 70% ethanol moistened cheesecloth (mainly large specimens of fish, amphibians, reptiles, birds and mammals with no free ethanol at time of shipping), 70% free ethanol (mainly smaller specimens with 30 mL or less) and 95% free ethanol in small quantities (tissue samples for DNA analysis in vials of 2-10 mL). Collections used mainly FedEx, UPS and DHL with other couriers represented in small numbers. Even though the vast majority of collections were shipping according to Part 3;5 of the Technical Instructions and DOT 49 CFR 173.4 and all collections staff were trained to pack, handle or ship (in no small part due to our organizations efforts at bringing everyone into compliance through organized workshops and training sessions like those held in Oklahoma), a more worrying indication was that some collections were still shipping internationally using USPS – either oblivious to the regulations or blatantly ignoring them due to the high costs involved.

1.6 The list of countries to which packages were sent and were bring returned from spanned the globe band included Argentina, Australia, Austria, Belgium, Bermuda, Brazil, Canada, Chile, Colombia, Costa Rica, Czech Republic, Denmark, France, French Polynesia, Germany, Greece, Hungary, Iceland, India, Indonesia, Italy, Japan, Mexico, New Caledonia, Netherlands, Netherland Antilles, New Zealand, Norway, Panama, Philippines, Poland, Portugal, Puerto Rico, Romania, Russia, Singapore, Slovakia, South Africa, South Korea, Spain, Sweden, Taiwan, Thailand, Turkey, United Kingdom and the United States.

1.7 Most respondents mentioned that with tightening budgets in Natural History Museums, they are having to employ mechanisms to save costs – either by curtailing shipping, or requesting that researchers pay for the shipping or visit the collection in person. Shipping costs were eroding budgetary lines earmarked for supplies and thus limiting the purchase of other much needed materials for collections care. Smaller museums in some cases simply cannot afford to process any material for shipment thus limiting access to important research materials. Museums could also no longer afford to pay for tracking and insurance on these packages due to the high costs of shipping via courier.

1.8 It was also revealed that collections were having problems with shipping packages to certain areas and even though some related to restrictions other than dangerous goods (permitting, veterinary inspection etc.); others were directly related to dangerous goods regulations. Chief amongst these were restrictions on dangerous goods shipping imposed by destination countries on the courier companies. These courier companies do not have the rights to trans-ship dangerous goods within certain destination countries and as such, packages could be shipped to international airports and no further either requiring the recipient to travel to the airport to receive the package or not receive it at all. The fact that the list of countries affected is ever changing, and varies by carrier, makes shipping a constantly changing landscape causing problems and frustration. The potential for package delays (causing damage to specimens through desiccation) and even destruction are greatly increased due to this factor. Specific countries mentioned were all South and Central American countries, Mexico, some European countries and Australia. These restrictions and problems are stifling international collaboration and taxonomic and ecological research efforts by a large number of scientists.

1.9 Of concern is also the fact that in a large number of cases material is shipped to researchers who are not themselves trained to pack and ship materials for return and do not have access to anyone who is. Museums thus struggle to get these packages returned in a proper manner even though guidelines are provided on the correct repackaging of these materials for return.

1.10 Another major concern was the large variation in interpretation of the regulations by customs officials, courier staff and museum staff. A huge amount of effort has been invested in attempting to navigate the regulations and present them in as legible a means as possible to our membership in order to avoid any confusion and potential fines and destruction of material due to non-compliance. Andy Bentley of the KU Biodiversity Institute recently wrote an article for Collection Forum (the peer reviewed journal of the Society for the Preservation of Natural History collections) entitled “Shipping and Handling of Natural History Specimens in Dangerous Goods” in an attempt to address numerous email questions received in this regard. A copy of this publication is enclosed.

1.11 Some collections had resorted to placing specimens in lower concentrations of ethanol (<24%) or water moistened cheesecloth to circumvent regulations even though this has distinct negative effects on the specimens through swelling and contraction of tissues and cell walls due to the numerous changes in concentration during the shipping and return process (from 70% to 24% to 70% to 24% to 70% again), especially if these specimens are shipped multiple times which is often the case over the life of a specimen.

1.12 Current shipping procedures vary depending on the type of specimen being sent. Superior packing is of critical importance since the specimens can suffer significant, permanent damage if allowed to dry out. Thus we take great pains (such as triple-bagging and the addition of both absorbent and shock-absorbing material) to ensure the specimens are well-protected. Great care and effort is taken to ensure specimens are not damaged in transit - each specimen is unique and irreplaceable.

1.13 The larger vertebrate and invertebrate specimens are removed from their storage jars and wrapped in cheesecloth moistened with 70% ethanol. The cheesecloth-wrapped specimens are then placed into a plastic bag. Next the bag is closed with a heat sealer. This bag is subsequently heat-sealed inside a second bag, which is then heat-sealed inside a third bag, along with an appropriate amount of absorbent material. The bags are then packed in sturdy cardboard boxes (200 lb test weight) and cushioned by Styrofoam packing "peanuts".

1.14 For delicate specimens, as well as tissue samples used in genetic research, that cannot withstand being wrapped in cheesecloth, the packing protocol varies slightly. Small specimens or tissues are placed in sealed glass or polypropylene vials which are filled with 30 mL or less of either 70% or 95% ethanol. These vials are then sealed in secondary and tertiary bags, again using a heat sealer, together with sufficient absorbent material.

1.15 The various scenarios thus include:

- Specimens wrapped in cheesecloth wet with 70% ethanol with little or no visible fluid at time of packaging, and
- Specimens (or parts thereof) placed in vials or other rigid containers with 30 mL or less of 70% or 95% ethanol visible fluid

1.16 An exception is thus requested to cover these various scenarios. This would have wide ranging implications for museums in monetary terms (training costs and shipping costs) as well as a substantial impact on research collaboration between international countries. There are obviously large quantities of these packages traversing the globe annually – a conservative estimate is that 100 times the packages collated from the survey are being sent on a yearly basis. It would be advantageous to everyone concerned to be "on the same page" so to speak.

1.17 There are also specimens that are shipped in 3.7% formaldehyde which, according to the DOT and ICAO dangerous goods tables are not regulated, but have been known to be rejected given that in some instances the material is deemed to be aviation regulated liquid - UN3334, due to the stipulation that "Any material, which has narcotic, noxious, irritating or other properties such that, in the event of spillage or leakage on an aircraft, could cause extreme annoyance or discomfort to crew members so as to prevent the correct performance of assigned duties. The materials included under this proper shipping name must not meet any of the definitions for Classes 1 through 8." Could we get clarification on this issue – are specimens packaged in the above way in 3.7% formaldehyde regulated and if so, is there a way this scenario could be included in the requested exception?

1.18 Another major area of concern was the carrying of specimens onto passenger aircraft as either hand carried or checked luggage. Large numbers of researchers collecting specimens in the field (sometimes in remote areas) have a need for bringing specimens back to their home institutions using this method. The specimens in question fall into the above categories – specimens wet with 70% ethanol wrapped in cheesecloth, tissues in small quantities of 95% ethanol, specimens wet with 3.7% formaldehyde wrapped in cheesecloth and small specimens in free 70% ethanol. These specimens are usually carried onboard in hand carry or checked baggage packaged as above, however they are usually

placed triple bagged directly into baggage (without the cushioning material or outer container). It would be greatly advantageous if a similar exception could be included for these specimens.

2. ACTION BY THE DGP-WG

2.1 The DGP-WG is invited to consider the adoption of a new special provision that would be assigned to the entries for UN 1170, **Ethanol**, **Ethanol solution**, **Ethyl alcohol**, and **Ethyl alcohol solution**, UN 1987 **alcohol (denatured ethanol)** and UN 1219, **Isopropanol** and **Isopropyl alcohol**.

2.2 The wording proposed for SP AXXX is as follows:

AXXX Museum specimens containing small quantities of UN 1170, UN 1987 or UN 1219 are not subject to these Instructions provided the following packing and marking requirements are met:

a) large specimens:

- 1) are wrapped in paper towel and/or cheesecloth moistened with ethanol or isopropanol;
- 2) the wrapped specimen is then placed in two layers of plastic bags, with each bag being individually heat sealed;
- 3) the bagged specimen is then placed inside a third plastic bag with absorbent material then heat sealed;
- 4) the finished specimen is then placed in a strong outer packaging with suitable cushioning material.

b) small specimens:

- 1) are placed in a plastic inner packaging with no more than 30 mL of ethanol or isopropanol;
- 2) the inner packaging is then placed in two layers of plastic bags, with each bag being individually heat sealed;
- 3) the bagged specimen is then placed inside a third plastic bag with absorbent material then heat sealed;
- 4) the finished specimen is then placed in a strong outer packaging with suitable cushioning material.

c) the completed package must be marked "scientific research specimens, not restricted special provision Axxx applies."

2.3 The DGP-WG is invited to consider if specimens packed with similar quantities of 3.7% formaldehyde are subject to the Technical Instructions. Packaging and marking would follow SP AXXX.

2.4 The DGP-WG is also invited to consider if provision should be made to permit the carriage of such specimens in checked and/or carry-on baggage. Packaging and marking may vary from SP AXXX in that heat sealing inner packages may not be feasible in remote collecting localities (in which case multiple Ziplock bags may be used. Specimens may sometimes be placed triple bagged, directly into luggage (in small quantities) but would usually be placed within a rigid outer container of some kind (drum, plastic vessel or liquipak).

APPENDIX A

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Shipping and handling of Natural History Specimens in Dangerous Goods

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Most collection holding natural history institutions, as part of their daily operating procedures deal with the shipping of specimens, through loans and gifts of material to other institutions as well as the accepting of incoming material. A large number of these shipments contain flammable or hazardous solutions e.g. ethanol, isopropanol or formaldehyde in varying concentrations. Dangerous goods regulations, most in place long before September 11th, 2001, were brought sharply into focus after that tragic event. The shipping and handling of natural history specimens in wet collections has been affected by the more rigorous enforcement of these regulations, which has impacted the methods and frequency with which museums and other collection-holding institutions can send loans and gifts of materials to others. There is a great deal of confusion concerning the application of these regulations which along with a lack of knowledge has resulted in serious misinterpretations of the regulations within the natural history community.

Most alcoholic specimen shipments (as long as no other permitting or documentation restrictions apply), whether domestic or international, are sent by airmail to minimize the length of time specimens are exposed to the hazards of transport, thereby reducing the chances of damage and dehydration. Shipping dangerous goods by air presents particular problems. International shipments must comply with both the International Civil Aviation Organization (ICAO) technical instructions as well as national regulations. In order to meet commercial standards, shippers are also required to meet the International Air Transport Association (IATA) Dangerous Goods Regulations. Furthermore, some countries have added variations to many of these requirements.

Regulating agencies

The ICAO governs the implementation and adoption of standard aircraft shipping and packaging regulations by both the Department of Transportation (DOT) in the United States and IATA internationally. DOT regulations are unique to the United States. Other countries have similar domestically enforced regulations while a large number rely on IATA regulations for both domestic and international regulations. Domestic shipments sent through the mail within the United States must also conform to United States Postal Service (USPS) regulations while courier shipments (FedEx, UPS and DHL) must conform to the individual company's specific regulations (which for the most part follow DOT or IATA regulations). USPS and private courier regulations must meet or exceed the DOT or IATA regulations respectively; in many instances they are more restrictive.

Training

The first, and most important, requirement stipulated by all regulations is that all who pack, handle or ship dangerous goods be properly trained and certified. Training can be obtained from any number of commercial companies that specialize in Dangerous Goods or Hazardous Materials Training, and may range in price from \$300-\$500. Training programs can take from a couple of hours to two days (depending on the scope and complexity of training) and cover general shipper's compliance and responsibilities together with specific case scenarios. Participants should be provided with a copy of the relevant regulations, and the training should cover restricted quantity (small quantities for DOT and excepted quantities for IATA) dangerous goods packing and shipping. For quantities above and beyond restricted quantities, more extensive training is required, which involves additional time and cost. The majority of museum shipments will fall within the restricted quantity regulations outlined below. Every employee who handles, packs or ships dangerous goods is required to complete this training and maintain

current certification. In addition, refresher training is required every 24 months. Depending on the size of the institution, the training of a single person (or two) to handle, pack and ship all dangerous goods shipments may be sufficient. At some institutions (especially those affiliated to universities) there may already be trained individuals (for example, in an environmental health and safety unit) who can ship and receive packages. University museums may also be able to make use of the institution's environmental health and safety unit for training of museum personnel, and for assistance with shipments larger than those covered by restricted quantities. There are also certified commercial re-packing companies that will handle packing and labeling requirements.

Dangerous goods/Hazardous materials

Dangerous goods/hazardous materials are classified according to Hazard Class and Packing Group. For example, most flammable liquids fall into Hazard Class 3 (flashpoint of less than 60.5° C or 141° F). Within Hazard Class 3, materials are classified into three Packing Groups. Materials in Packing Group I, considered the most dangerous, have a boiling point less than or equal to 35° C (95° F). Materials in Packing Group II, considered moderately dangerous, have a boiling point above 35° C (95° F) and a flashpoint less than 23° C (73° F). Materials in Packing Group III have a boiling point above 35° C (95° F) and a flashpoint between 23° C (73° F) and 60° C (140° F).

Of the four substances most commonly used in wet collections only ethanol, isopropanol and formaldehyde are covered under dangerous goods regulations. Glycerin (glycerol) used for cleared and stained specimens, is not regulated in any concentration.

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.

Table 1: Flash Points of Ethanol based Water Solutions

Conc. (% by volume)		0	10	20	30	40	50	60	70	80	90	100
Temperature	(° F)	-	135	105	90	80	80	80	80	75	65	55
	(° C)	-	57	41	32	27	27	27	27	24	18	13
Packing Group		PG III									PG II	

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.

Table 2: Flash Points of Isopropanol based Water Solutions

Conc. (% by volume)		0	10	20	30	40	50	60	70	80	90	100
Temperature	(° F)	-	105	85	75	70	65	65	65	65	65	53
	(° C)	-	41	29	24	21	18	18	18	18	18	12

Packing Group		PG III	PG II
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Formaldehyde (formalin), usually sold as a saturated solution of formaldehyde gas in water and measured by weight or volume concentration, is most commonly used in concentrations of 3.7% or 4.0% (what is called 10% formalin in natural history collections) and is unregulated for transport. Above 10% is a Class 9, packing group III substance and is regulated for transport.

Other solutions used in tissue storage include dimethyl sulfoxide (DMSO), propylene glycol and proprietary solutions such as RNAlater. DMSO and propylene glycol are unregulated in any concentration. RNAlater is proprietary (of unknown composition, although thought to be made up primarily of propylene glycol), but is not listed as a dangerous good.

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, and are outside the subject of this paper. There may also be ancillary permitting/documentation requirements for the domestic or international transfer of biological specimens (U.S. Fish and Wildlife import/export or CITES permits, APHIS, etc.). APHIS in particular has specific approved treatment methods required for import of specimens of avian, ruminant, equine and swine. These regulations (when relevant) should be adhered to during the transport of any natural history materials.

Regulations

Domestic and international shipping and packing guidelines vary slightly in scope and limitations but both include special dispensations for smaller quantities of dangerous goods. The two sets of limited quantity regulations are very similar in scope and content but have a number of limitations that must be adhered to. It is important to consult the original texts of both the DOT and IATA regulations before shipping. USPS and DOT regulations are available online^{1,2} while IATA regulations must be purchased³.

Domestic Regulations

In the United States, the shipment of dangerous goods (referred to as hazardous materials) are covered in DOT Title 49 CFR¹ (Parts 100 to 185) and USPS Publication 52². 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 utilizing these small quantity regulations. Institutions in other countries should consult their national dangerous goods regulations to ascertain if similar regulations exist and ensure compliance. In some instances this may mean using IATA regulations as outlined below in the international section of this document. Outlined below are the important relevant points from the DOT and USPS regulations:

1. Small quantities may be sent through the United States Postal Service 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.
2. Class 3 dangerous goods (all packing groups) are acceptable (ethanol and isopropanol).
3. 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. A removable closure on an inner receptacle must be held securely in place using wire, tape or other positive 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) which complies with DOT mandated drop and compressive load tests without breakage or leakage from any internal receptacle:
 - a. Drop tests – 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.
 - b. Compressive load test – stack packages of similar size and weight to a height of no less than 3m (10 feet) for 24 hours.
7. The gross mass of the package must not exceed 29 kg (64 pounds).
8. Labeling - 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. We have had custom labels produced that follow these guidelines:



International Regulations

International shipments of dangerous goods are covered in Section 2.7³ of the IATA regulations. As above, restricted quantity regulations exist for international shipping, contained in IATA Section 2.7.1 and referred to as “Dangerous Goods in Excepted Quantities”. Dangerous goods in excepted quantities, in contrast to DOT and USPS regulations, are considered dangerous goods under IATA regulations but are exempt from large portions of the dangerous goods regulations applicable to larger quantities.

1. The United States Postal Service may not be used for international shipping of dangerous goods. All international shipments must be sent using a private courier service (FedEx, UPS or DHL) while adhering to IATA regulations..
2. Class 3 dangerous goods (all packing groups) are acceptable.
3. As above, each inner receptacle may not contain more than 30 mL while the same construction, liquid full and closure security regulations apply.
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 same package drop and compressive load test regulations as above apply.

7. IATA regulations state that each inner receptacle must be placed within a securely sealed secondary packaging the total contents of which may not exceed 500 mL for Packing Group II liquids and 1 liter for Packing Group III liquids.
8. Labeling – each package must be labeled with the label below (Figure 1), having minimum dimensions of 100mm x 100mm (4" x 4"). This label must be completed and signed by the packer. The "Nature and Quantity of Goods" section of the air waybill must be completed with the words "Dangerous Goods in Excepted Quantities".

DANGEROUS GOODS IN EXCEPTED QUANTITIES

This package contains dangerous goods in excepted small quantities and is in all respects in compliance with the applicable international and national government regulations and the IATA Dangerous Goods Regulations

Signature of Shipper

Title

Date

Name and address of Shipper

This package contains substance(s) in Class(es)
(check applicable box(es))

Class: 2 3 4 5 6 8 9

and the applicable UN Numbers are:

Figure 1: Dangerous goods in excepted quantities label for international shipments.

All three major courier services (FedEx, UPS and DHL) accept dangerous goods in excepted quantities for international delivery^{4,5,6} and waive their normal dangerous goods surcharges for packages containing excepted quantities. All three couriers do, however, only accept dangerous goods on a contract or pre-approval basis and will only accept dangerous goods in boxes (no envelopes). FedEx has the added stipulation that the box must measure at least 7" x 4" x 4". All three companies will only ship dangerous goods to approved countries as there are various countries within which they are prohibited from shipping (due in part to these countries not adopting IATA dangerous goods regulations for domestic transport). This means that the courier could deliver a package to the designated international airport but no further. There are also various countries where shipment is allowed but only to certain regions or postal codes. The list of countries to which this applies changes constantly therefore the courier should be contacted for an up-to-date list^{4,5,6}. It should also be noted that in some countries, additional customs, veterinary, or fish and wildlife fees may be incurred which will need to be paid by the recipient of the package. The list of these fees and to which countries they apply is not available or, in most cases, unknown to the courier.

It has recently been noted that FedEx has regulations in place against the carrying of "whole dead animals" and that museum specimens fall into this category and are therefore prohibited in

FedEx mail. There are various groups working with FedEx to institute exempt status for museum specimens and resolve this impasse.

Transport in personal baggage as carry-on or checked luggage

With so many variables and so many different people and organizations to deal with, there are inevitably differences in interpretation of regulations--for these reasons, I do not recommend attempting transporting specimens on board an airplane. In the majority of cases it is easier and safer to send the specimens by courier.

Due to the fact that DOT defines small quantities as non-hazardous, these quantities are allowed in hand and checked baggage on domestic flights but must be declared to the airline staff before boarding. The final decision as to whether or not to accept these packages is made by the pilot of the aircraft being boarded, thus you may be denied permission to carry the package on board at the last minute. Whether or not the package will be allowed on board varies from flight to flight and from airline to airline. Some individuals have suggested simply pouring off the excess liquid preservative before flying but there is no guarantee that this will be acceptable and it has yet to be determined whether removing liquid alcohol from specimens and carrying them "dry" would negate the need to declare these as dangerous.

With the present heightened security measures in force at airports and the policy of no liquids or gels (or limited to 3 oz bottles in a clear quart zip-lock bag depending on which airport you fly through) no specimens in fluid would be allowed as carry-on baggage at all.

Internationally, dangerous goods in any quantity are prohibited as carry-on or checked baggage and cannot be carried on your person or checked onto any international flight (IATA Section 2.7.3).

Natural history specimens

In real world collection scenarios, the common practice of wrapping specimens in cheese cloth or gauze moistened with alcohol and sealed in plastic would keep the material from being a dangerous good 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. Each package would need to be placed in secondary packaging material (usually another bag) sealed in the same way and with sufficient absorbent material (vermiculite or 3M sorbent pad) and then placed in an approved box with cushioning material (packing peanuts). I have found that purchasing variable size boxes that can be cut down to the appropriate size (available from ULINE) reduces the number of different sized boxes we need to keep on hand. It is recommended that old boxes not be re-used for shipping specimens, as they may have old labels that cause confusion at mailing facilities. All old labels must be defaced or removed before packing.

Specimens preserved in 3.7% formaldehyde can be shipped in regular mail both domestically and internationally without any dangerous goods requirements.

Tissues 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.

Although it is widely believed that reducing the concentration of the alcohol below 24% renders specimens outside of the scope of dangerous goods regulations, from Table 1 and 2 this is clearly not the case. Even at concentrations of 10%, both ethanol and isopropanol fall within the bounds of Packing Group III (flash points greater than 23°C and less than 60°C). The confusion stems from passages in the IATA regulations (Section 2.3) pertaining to beverage alcohol which state that "alcoholic beverages containing 24% or less alcohol by volume are not subject to any

restrictions". This regulation only pertains to beverage alcohol in retail packaging and cannot be used for natural history specimens.

It has also been suggested that fluid preserved specimens may be placed in water for shipment. Although this may put specimens outside of the scope of dangerous goods regulations, the possibility of damage to specimens from swelling (and subsequent shrinkage upon reinsertion into alcohol), cell wall rupture, mold, and bacterial growth will severely endanger the specimens, particularly if the shipment is delayed.

Problems and concerns

These two scenarios cover the majority of all natural history dangerous goods shipments but there are still some areas of concern or where problems still exist:

1. Large specimens that require more than 30 mL to adequately moisten the specimen for transport must be packaged as regular dangerous goods (not excepted/small quantities) and are subject to the more restrictive regulations, labeling and paperwork of such shipments.
2. Specimens may not be sent to countries that do not accept dangerous goods. At present there is no solution to this problem.
3. Specimens may not be carried internationally as carry-on or checked baggage due to dangerous goods restrictions. As discussed above, it has yet to be determined whether specimens can be drained of alcohol thereby negating the need to declare them as dangerous goods.
4. Specimens sent on loan to researchers who have not had the necessary training to repack and return the material (or have no access to a certified packer) once they have completed their study can also pose a problem. This is especially pertinent for international shipments as regulations and training requirements differ between countries.
5. According to the regulations, packages entering the USPS postal system (whether sent as loan, gift or exchange) by international institutions and packed by untrained staff should be refused and returned to the sender. I do not know of anyone who would do this (thereby endangering the specimens to the vagaries of the international postal system a second time), and this would also expose the postal system to an illegal package a second time that may not have been packaged correctly or may be leaking fluid.

It is important to remember that dangerous goods regulations are not written to specifically address the shipment of natural history specimens. This is a shortcoming that we would like to address through the planning of a meeting at which all of these issues will be discussed with representatives of all involved parties – ICAO, IATA, DOT, USPS, FedEx, UPS and DHL. I have been working in conjunction with the Society for the Preservation of Natural History Collections (SPNHC) and the American Society of Ichthyologists and Herpetologists (ASIH) to put together such a meeting. However, even if we were successful in having legislation written specifically for natural history specimens, this legislation would take five to six years to take effect. Clearly, a short term solution to these problems is necessary and I will be working to achieve this and will keep the community updated on any progress made.

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>

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- ³ IATA Dangerous Goods Regulations, 48th Edition. 2007. Section 2 - Limitations pgs 9-80. International Air Transport Association. 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.

Addendum

SPNHC newsletter Vol 23 (1): 17-18 (2009)

IATA Excepted Quantity Regulations in 50th Edition

IATA regulations for Excepted Quantities have been revised in the new edition of the IATA regulations (50th Edition). Here I outline the changes and how they affect the shipment of natural history specimens.

NB: Remember, you need to be trained and certified in dangerous goods handling, packing and shipping in order to use these regulations to ship dangerous goods in excepted quantities internationally or domestically. Institutions also need to be registered with FedEx, UPS or DHL in order for them to handle such packages.

The Section of the regulations dealing with Excepted Quantities is still 2.7. Thank you to Brendan Sullivan at IATA for providing additional information regarding specific UN numbers. Brendan (who attended our SPNHC 2008 meeting round table on dangerous goods) together with Dave Brennan have been a great help in our endeavors to sort out issues regarding the international shipping of fluid preserved natural history specimens. The wording of a large proportion of the regulations has changed and is now less vebose and easier to understand.

There are three sections that have changed significantly that have potential or immediate implications for us:

1. Section 2.7.2.2 Dangerous goods Permitted in Excepted Quantities – Specific UN numbers have been added to some of the sections. None of our standard substances are listed here but please check to ensure that any of the UN numbers listed in Class 3 (UN 1204 – nitroglycerine in alcohol, UN 2059 – nitrocellulose solution and UN 3473 – fuel cell cartridges) do not apply to you before shipping. Not likely, but still worth a mention!!
2. Table 2.7.A - This table in the old version of the regulations was a generic table by Class/Division and Packing Group and outlined allowable quantities of inner and outer packages:

TABLE 2.7.A
Excepted Quantity (Limits) Inner and Outer Packaging (2.7.5)

PACKING GROUP OF THE SUBSTANCE CLASS or DIVISION of PRIMARY or SUBSIDIARY RISK ^a	PACKING GROUP I		PACKING GROUP II		PACKING GROUP III	
	Packagings		Packagings		Packagings	
	Inner	Outer	Inner	Outer	Inner	Outer
1: Explosives	Forbidden					
2.1: Flammable gas	Forbidden					
2.2: Non-Flammable, non-toxic gas	See Note ^b					
2.3: Toxic gas	Forbidden ^c					
3: Flammable liquid	30 mL	300 mL	30 mL	500 mL	30 mL	1 L
4.1: Self reactive substances	Forbidden		Forbidden		Forbidden	
4.1: Other flammable solids	Forbidden		30 g	500 g	30 g	1 kg
4.2: Pyrophoric substances	Forbidden		Not Applicable		Not Applicable	
4.2: Spontaneously combustible substances	Not Applicable		30 g	500 g	30 g	1 kg
4.3: Water reactive substances	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
5.1: Oxidisers	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
5.2: Organic peroxides ^d	Not Applicable		30 g or 30 mL	500 g or 250 mL	Not Applicable	
6.1: Toxic substances — inhalation	Forbidden		1 g or 1 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
6.1: Toxic substances — oral	1 g or 1 mL	300 g or 300 mL	1 g or 1 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
6.1: Toxic substances — dermal	1 g or 1 mL	300 g or 300 mL	1 g or 1 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
6.2: Infectious substances	Forbidden					
7: Radioactive material ^e	Forbidden					
8: Corrosive materials ^f	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
9: Magnetized materials	Forbidden					
9: Other miscellaneous materials ^g	Not Applicable		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L

This has now been changed to the following in the new version and is based entirely on the specific UN numbers involved:

TABLE 2.7.A
Excepted Quantity Codes for Table 4.2 (2.7.4.1)

Code	Maximum quantity per inner packaging	Maximum quantity per outer packaging
E0	Not permitted as Excepted Quantity	
E1	30g/30mL	1kg/1L
E2	30g/30mL	500g/500mL
E3	30g/30mL	300g/300mL
E4	1g/1mL	500g/500mL
E5	1g/1mL	300g/300mL

You are now required to look up the UN number of the particular substance you are shipping in the dangerous goods table and find the "E" code for the relevant packing group of that substance. The substance may only be shipped if an "E" number appears in the relevant column in the dangerous goods table. As supplied by Brendan, here are the entries for ethanol,

isopropanol, denatured alcohol and formaldehyde (in concentrations greater than 25% – the most common substances we ship using this method.

Ethanol – Class 3, Packing group II (concentration of 90% and above) is code E2 which according to Table 2.7.A allows 30ml inner/500ml outer package.

Ethanol – Class 3, Packing group III (concentration less than 90%) is code E1 which according to Table 2.7.A allows 30ml inner/1000ml outer package.

Isopropanol – Class 3, Packing Group II (concentrations higher than 40%) is code E2 which according to Table 2.7.A allows 30ml inner/500ml outer package.

Denatured alcohol – Class 3, Packing Group II is Code E2 as above.

Formaldehyde (at concentrations greater than 25%) - Class 8, Packing Group III is Code E1 which according to Table 2.7.A allows 30ml inner/1000ml outer package.

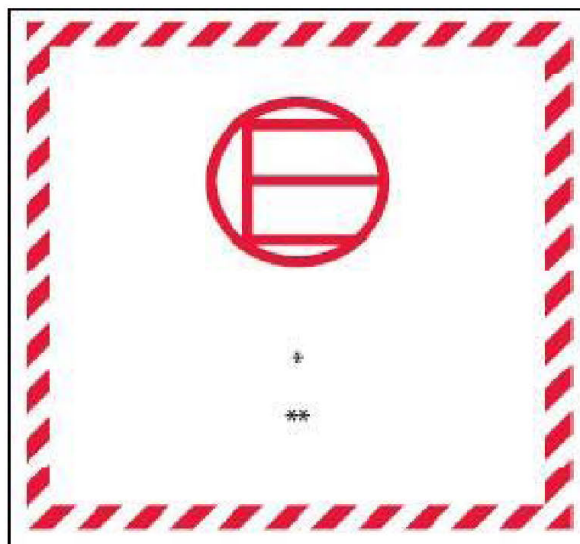
According to the dangerous goods table, formaldehyde at concentrations less than 25% but greater than 10% is considered Aviation Regulated Liquid (UN 3334) while concentrations less than 10% are not regulated. However, Brendan did mention that this may still fall into the classification of UN 3334 due to the following catch phrase in the wording of this regulation:

“Any material, which has narcotic, noxious, irritating or other properties such that, in the event of spillage or leakage on an aircraft, could cause extreme annoyance or discomfort to crew members so as to prevent the correct performance of assigned duties. The materials included under this proper shipping name must not meet any of the definitions for Classes 1 through 8.”

So, in general nothing has changed for the substances in question but, for all other substances, the new method would need to be used in order to check quantity requirements.

This is an improved system as it relies on the flammability risk of the substance in question rather than a generic formula across the board.

3. Labeling – the label for package marking has changed to the following with immediate effect (no grace period – packages sent out with the old label run the risk of being rejected):



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This is actually simpler than the old version in that the only information that needs to be supplied is:

- * - The Class of substance – which in our case would be Class 3 for all liquids – just place a 3 in this position.
- ** - The name of the shipper or consignee **if not shown elsewhere on the package. If you are sending by courier the sender's name is on the courier label and so can be omitted here.**

They have also added the provision whereby the label can be red **or black** on white or contrasting background. This presumably allows for photocopied versions to be used which will save on cost. These labels cost approximately \$40 for a roll of 500 (which, as far as I could tell, is the minimum order available over the web).

Packing and package testing requirements have not changed.

APPENDIX B

October 9, 2007

Andrew C. Bentley
Natural History Museum
Dyche Hall
1345 Jayhawk Boulevard
Lawrence, KS 66045-7561

Dear Mr. Bentley:

This responds to your request for a ruling on the applicability of USPS hazardous goods requirements as detailed in the *Domestic Mail Manual (DMM)* and *Publication 52 Hazardous, Restricted, and Perishable Mail* when mailing preserved museum specimens.

I understand that your specimens are removed from their ethanol solution and wrapped in ethanol-moistened cheesecloth to prevent desiccation of the specimen while in transit. Each specimen is then individually placed in a heat sealed package. No visible amounts of liquid ethanol solution are present in the individually packaged specimens. These individually packaged specimens are then all contained within another heat sealed package, along with appropriate absorbent materials. The package or packages are then suspended in packing peanuts within a 200lb test corrugated carton.

You have provided a ruling from the Department of Transportation indicating their position that the packaging procedures and methods you use for shipping the specimens mitigate the minimal hazard that may be present during transportation to the extent that the specimens are not subject to regulation under the Hazardous Materials Regulations found in 49 CFR Parts 171-180.

The minute quantities of ethanol solution contained within each specimen, coupled with the rigorous packaging procedures followed by the Museum, reduce any risk associated with the presence of the ethanol to a *de minimus* level beneath the scope of the hazardous material regulations contained within DMM 601.10 and Publication 52 Chapter 3. The specimens are subject to any specific restrictions contained in the *International Mail Manual Individual Country Listings*.

This opinion is granted with the understanding that I may rescind this decision if we develop a safety concern or find a negative impact on postal operations.

I appreciate your interest in the Postal Service, and I am pleased to provide you with this mailing solution. Please contact Mike Lee of my staff at 202-268-7263 if you have any questions.

Sincerely,



Sharon Daniel
Manager

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

cc: Manager, PCSC 10007-2951

P&C:MS:mlee:Pub52 – 334:DMM601.10

475 L'ENFANT PLAZA SW
WASHINGTON, DC 20260-3436
www.usps.com

APPENDIX C



U.S. Department
of Transportation

Pipeline and Hazardous Materials
Safety Administration

DEC 22 2008

Mr. Andrew Bentley
Biodiversity Research Institute
University of Kansas
1345 Jayhawk Boulevard
Lawrence, KS 66045

1200 New Jersey Ave., SE
Washington, DC 20590

Ref. No.: 08-0209

Dear Mr. Bentley:

This responds to your letter regarding the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180) as they apply to the transportation of fluid preserved research specimens of mammals, birds, fishes, insects and other invertebrates, and amphibians and reptiles. While many of your specimens are "dry" (skeletons, skins, pinned insects), a significant number are stored or transported moistened in 70% ethanol solution, a standard practice in natural history museums worldwide. Still others are stored or transported "wet" in 95% ethanol for genetic or DNA extraction purposes.

You state that you represent two organizations whose members include natural history museums and collections worldwide (The Society for Preservation of Natural History Collections (SPNHC) and the Natural Science Collections Alliance (NSCA)). You have been tasked with attempting to resolve issues involving shipping specimens both domestically and internationally between museums and individual researchers studying the life of the planet as it pertains to biodiversity, ecology, genetics, conservation, evolution, and virtually any other aspect of natural history.

Your members were discussing two previous interpretations regarding zoology specimens shipped in 70% ethanol solution (Ref. No. 05-0139; 8/9/05) and invertebrates stored in 70% ethanol solution (Ref. No. 07-0076; 8/2/07). Specifically, you asked for clarification of these responses. Your current shipping procedures vary depending on the type of specimen being shipped. The various scenarios include:

- Specimens wrapped in cheesecloth wet with 70% ethanol with little or no visible fluid at time of packaging, and
- Specimens placed in vials or other rigid containers with 30 ml or less of 70% or 95% ethanol (fluid preserved specimens)

Your current shipping procedures use triple-bagging and absorbent and shock-absorbing material to protect the specimens. The larger vertebrate and invertebrate specimens are removed from their storage jars and wrapped in cheesecloth moistened with 70% ethanol.

The cheesecloth-wrapped specimens are then placed into a plastic bag. The bag is closed with a heat sealer. The bag is subsequently heat-sealed inside a second bag, which is then heat-sealed inside a third bag, along with an appropriate amount of absorbent material. The bags are then packed in sturdy cardboard boxes (200 lb test weight) and cushioned by Styrofoam packing "peanuts".

The previous responses were provided on a case-by-case basis, and do not necessarily address all types of transportation scenarios. The two previous requests for interpretation described the packing methods used in both scenarios as having "little or no visible free-flowing liquid at the time they are sealed." Consequently, it was our opinion that the procedures and methods described in these letters and used for shipment of the cheesecloth-wrapped specimens moistened with 70% ethanol to protect the specimens from drying out and damage, and the fluid preserved dry specimens in shell vials of less than 30 ml of 70% ethanol to prevent desiccation, mitigate the minimal hazard that may be present during transportation.

Based on the information provided in your letter, it is the opinion of this Office that in accordance §173.120(d), shipments of zoological specimens preserved in ethanol that are packaged as described in your letter are not subject to regulation under the HMR.

I hope this information is helpful. If we can be of further assistance, please contact us.

Sincerely



Charles E. Betts
Chief, Standards Development
Office of Hazardous Materials Standards

— END —