CHAPTER 1.1.2.

TRANSPORT OF SPECIMENS OF ANIMAL ORIGIN

INTRODUCTION

The transport of infectious substances is covered by international regulations that are updated on a regular basis and are widely accessible via the internet, or through commercial and regulatory transportation affiliates. The World Health Organization (*WHO*) *guidance document on "Transport of Infectious substances" summarising the different transport regulations is regularly updated. This chapter is based on international regulations and adapted accordingly, to best cover the transport requirements for veterinarians transporting samples from the field to laboratories, as well for transportation between veterinary laboratories within a country. Practical explanation on how to transport biological substances according to the specific dangerous goods transport regulations will be explained in this chapter.*

This chapter will focus on the transport of specimens that are non-hazardous for humans or animals or where there is a minimal likelihood that pathogens are present (*exempt specimens*). *It will briefly touch on infectious substances, including diagnostic materials and is based on international transport regulations. Specific examples for veterinary laboratories are provided.*

The international regulations for the transport of infectious substances by any mode of transport are based upon the Recommendations made by the Committee of Experts on the Transport of Dangerous Goods (*UNCETDG*), *a committee of the United Nations Economic and Social Council. The Recommendations are presented in the form of Model Regulations covering rail, road, sea and post.*

A. BASIC PRINCIPLES

In the interest of veterinary public health, animal specimens must be transported safely, timely, efficiently and legally from the place where they are collected to the place where they are analysed. The collection of specimens from animals in the field is covered in Chapter 1.1.1 *Collection, submission and storage of diagnostic specimens*. All specimens should be packaged and transported in accordance with local, national and international regulations. The procedures should minimise the risk of exposure for those engaged in transportation and should protect the environment and susceptible animal populations from potential exposures. Additionally inefficient packaging that allows for damage or leakage will likely delay the delivery of the shipment to the laboratory, delaying or preventing critical laboratory analyses from being performed. Specimens should always be packaged and transported to protect the integrity of the specimens, as well as to avoid cross-contaminating other specimens. Minimal requirements for the transport of specimens follow the principle of triple packaging, consisting of three layers as described below:

- *Primary inner receptacle:* A primary watertight, leak-proof or stiff-proof receptacle containing the specimen. The receptacle is packaged with enough absorbent material (e.g. cellulose wadding, paper towels, house hold paper, cotton balls) between the primary and the secondary container to absorb all fluid in case of breakage. Even though the regulations do not prohibit glass, primary receptacles should preferably not be breakable. In addition, they should not contain any sharps (e.g. vacutainer with needle), particularly when using soft secondary and outer containers.

- *Secondary packaging:* A second durable, watertight, leak-proof packaging to enclose and protect the primary receptacle(s) (e.g. sealed plastic bag, plastic container, screw-cap can). Several cushioned primary receptacles may be placed in one secondary packaging, but sufficient additional absorbent material shall be used to absorb all fluid in case of breakage.

- *Outer packaging:* Secondary packaging is placed in outer shipping packaging (e.g. sturdy cardboard box, rigid cooler) with suitable cushioning material. Outer packaging protects the contents from outside influences, such as physical damage, while in transit.

Biological materials should be prepared for shipment by personnel that are trained and competent in packaging procedures and also knowledgeable of the shipping requirements and regulations. Whenever possible, specimens should be directly transported to the laboratory to ensure a rapid and reliable system using individuals that are trained and competent in the shipping and transportation process. The laboratory receiving the specimens must be informed in advance of the time and mode of the arrival of the specimens in order to be prepared to receive the specimen.

B. DEFINITIONS OF SPECIMENS TO BE TRANSPORTED

Definitions are based on the United Nations Model Regulations and are italicised.

1. Infectious substances

For the purposes of transport, infectious substances are defined as substances which are known or are reasonably expected to contain pathogens. Pathogens are defined as micro-organisms (*including bacteria, viruses, rickettsiae, parasites, fungi*) *and other agents such as prions, which can cause disease in humans or animals. Infectious substances can be classified into the following two categories:*

a) Category A

An infectious substance which is transported in a form that, when exposure to it occurs, is capable of causing permanent disability, life-threatening or fatal disease in otherwise healthy humans or animals. Indicative examples of substances that meet these criteria are given in the table A.

Note: Some organisms are considered Category A only when in culture form. New or emerging pathogens that do not appear on the list but meet the criteria, must also be transported as Category A.

b) Category B

An infectious substance which does not meet the criteria for inclusion in Category A.

Most laboratory submissions (apart from exempt specimens – see below) fall into this category. The official nomenclature for shipping is “Biological Substance, Category B” (formerly “Diagnostic Specimens”)

2. Cultures

Cultures are the result of a process by which pathogens are intentionally propagated. This definition does not include human or animal patient specimens as defined below.

3. Patient specimens

Patient specimens are human or animal materials, collected directly from humans or animals, including, but not limited to, excreta, secreta, blood and its components, tissue and tissue fluid swabs, and body parts being transported for purposes such as research, diagnosis, investigational activities, disease treatment and prevention.

4. Biological products

Biological products are those products derived from living organisms which are manufactured and distributed in accordance with the requirements of appropriate national authorities, which may have special licensing requirements, and are used either for prevention, treatment, or diagnosis of disease in humans or animals, or for development, experimental or investigational purposes related thereto. They include, but are not limited to, finished or unfinished products such as vaccines.

5. Genetically modified micro-organisms (GMMOs) and organisms (GMOs)

Genetically modified micro-organisms not meeting the definition of infectious substance are classified in Class 9 (*Miscellaneous dangerous substances and articles, including environmentally hazardous substances*). *GMMOs and GMOs are not subject to dangerous goods regulations when authorised for use by the competent authorities*

of the countries of origin, transit and destination. Genetically modified live animals shall be transported under terms and conditions of the competent authorities of the countries of origin and destination. DNA, RNA or plasmids are not considered as GMMO and not subject to dangerous goods regulations.

6. Medical or clinical wastes

Medical or clinical wastes are wastes derived from the medical treatment of animals or humans or from bio-research.

7. Responsibilities

The efficient transport and transfer of substances requires co-ordination between the sender, the carrier and the receiver to ensure that the material is transported safely and arrives on time and in good condition.

It is the responsibility of the sender to ensure the correct classification, packaging, labelling and documentation of all substances destined for transport.

a) The sender (shipper, consignor)

i) Makes advance arrangements with the receiver including investigating the need for import/export permits;

ii) Makes advance arrangements with the carrier to ensure:

a) that the shipment will be accepted for appropriate transport;

b) that the shipment (direct transport if possible) is undertaken by the most direct routing;

iii) Prepares necessary documentation, including permits, dispatch and shipping documents if necessary;

iv) Notifies the receiver of transportation arrangements once these have been made, well in advance of the expected arrival time.

b) The carrier

i) Provides advice to the sender regarding the necessary shipping documents and instructions for their completion;

ii) Provides advice to the sender about correct packaging;

iii) Assists the sender in arranging the most direct routing and then confirms the routing and provides, if possible, ways to track the parcel;

iv) Maintains and archives the documentation for shipment and transport.

c) The receiver (consignee)

i) Obtains the necessary authorisation(s) from national authorities for the importation of the material;

ii) Provides the sender with the required import permit(s), letter(s) of authorisation, or other document(s) required by the national authorities;

iii) Arranges for the most timely and efficient collection on arrival;

iv) Should acknowledge receipt to the sender.

Shipments should not be dispatched until all the necessary arrangements between the sender, carrier and receiver have been made.

8. Exemptions

Judgment by trained and competent laboratory professionals is required to determine if samples to be shipped are qualified as hazardous to humans or to animals or are exempt for shipping purposes. That judgment should be based on the known medical history of the animal(s), signs and individual circumstances of the specimen source, and endemic local disease conditions.

Specimens that do not contain infectious substances are not subject to dangerous goods regulations.

Substances containing micro-organisms that are non-pathogenic to humans or animals are not subject to dangerous goods regulations, unless they meet the criteria for inclusion in another class.

Substances in a form in which any pathogens present have been neutralised or inactivated such that they no longer pose a health risk are not subject to dangerous goods regulations, unless they meet the criteria for inclusion in another class.

Environmental specimens (*including food and water specimens*) *that are not considered to pose a significant risk of infection are not subject to dangerous goods regulations, unless they meet the criteria for inclusion in another class.*

Dried blood spots, collected by applying a drop of blood onto absorbent material, or faecal occult blood screening tests are not subject to dangerous goods regulations.

Human or animal specimens for which there is minimal likelihood that pathogens are present are not subject to dangerous goods regulation if the specimen is carried in a packaging which will prevent any leakage (*three layer principle, see Section A. Basic principles*) *and which is marked with the words "Exempt human specimens" or "Exempt animal specimens", as appropriate.*

Examples of specimens in the veterinary field *which may be transported as exempt* include specimens from surveillance studies, export controls of healthy animals (e.g. certification of freedom from classical swine fever) or determination of immune status of individual animals or populations (post-vaccination).

Samples containing DNA, RNA or plasmids (except prions) are not covered by the dangerous goods transport regulation. If these specimens are shipped in liquid form it is recommended to use the packaging system described below. If they are shipped on filter paper it can be shipped as regular mail. There may be specific regulations in place in some countries for the shipment, export or import of nucleic acids.

If it is likely that pathogens present in the specimens can cause harm to the human or animal population if exposed, then they must be assigned either to category A or B.

a) Packaging for exemptions

Specimens should always be packaged and transported to protect the integrity of the specimens. The basic principle of the three-layer system may apply for these specimens as well.

The three-layer system consists of the following elements:

i) *a leak-proof primary receptacle*(*s*) (*avoid glass containers*);

ii) *a leak-proof secondary packaging* (*e.g. plastic container or tight plastic bag*); *and*

iii) *an outer packaging of adequate strength for its capacity, mass and intended use, and with at least one surface having minimum dimensions of 10 cm × 10 cm;* (*e.g. plastic envelope or box, cardboard box, plasticised paper envelope*). *Paper envelopes for letters are not considered as suitable outer packaging*.

For liquids, absorbent material in sufficient quantity to absorb the entire contents should be placed between the primary receptacle(*s*) *and the secondary packaging so that, during transport, any release or leak of a liquid substance will not reach the outer packaging and will not compromise the integrity of the cushioning material.* Different types of absorbent material can be used (e.g. paper towels, household paper, toilet paper or any other suitable material).

b) Documentation and marking

The submission form, with information and case history, sent with the specimens should be placed in a plastic bag between the secondary and the outer packaging and on the outside of the consignment. Further guidance on information to be sent with the specimens can be found in chapter 1.1.1.

Individual specimens should be clearly identified using appropriate methods. Markings should withstand the condition of use, i.e. being wet or frozen. Attached plastic labels will fall off if stored at –70°C or use of wrong pencils may rub off containers.

The outer package of samples from *animal specimens for which there is minimal likelihood that pathogens are present* should be marked with the words *"Exempt animal specimen".*

NOTE: *For air transport, packagings for specimens exempted under this paragraph shall meet the packaging and marking described above.*

C. TRANSPORT OF INFECTIOUS SUBSTANCES, CATEGORY A (UN 2814 OR UN 2900)

Due to the nature of category A specimens which contain highly hazardous micro-organisms, more stringent packaging and transport regulations apply. Category A substances, although not necessarily a human pathogen, may have a high economic or trade impact on specific countries should there be release to the environment. Therefore other infectious substances may be added to this list by individual countries (e.g. cultures of Newcastle disease virus where the virus is exotic to the country or region). Furthermore, for those micro-organisms listed as category A infectious substances (cultures only), patient specimens of these pathogens do not require category A transport practices. For these specimens Category B transport practices should be applied.

Due to the highly hazardous nature of the Category A samples the packaging must meet special requirements. The principle of three layers also applies here, and the transport containers and outer packaging must meet the criteria defined in the relevant regulations, which can be found in Section J (e.g. the packaging must be UN certified and must have passed specific tests). The packages are marked to provide information about the contents of the package, the nature of the hazard and the packaging standards applied (e.g. "*INFECTIOUS SUBSTANCE, AFFECTING HUMANS*; UN 2814" or "*INFECTIOUS SUBSTANCE, AFFECTING ANIMALS ONLY*; UN 2900").

Furthermore, personnel packing, shipping or transporting Category A specimens are required to be specially trained and certified according to international regulations. This approval typically involves attendance at approved courses and passing of examinations.

Table A: *Examples of infectious substances included in Category A (indicative list)*

Indicative examples of infectious substances included in Category A in any form unless otherwise indicated	
UN number and proper shipping name	**Micro-organism**
UN 2814 Infectious substance, affecting humans	*Bacillus anthracis* (cultures only)
	Brucella abortus (cultures only)
	Brucella melitensis (cultures only)
	Brucella suis (cultures only)
	Burkholderia mallei – Pseudomonas mallei – glanders (cultures only)
	Burkholderia pseudomallei – Pseudomonas pseudomallei (cultures only)
	Chlamydia psittaci – avian strains (cultures only)
	Clostridium botulinum (cultures only)
	Coccidioides immitis (cultures only)
	Coxiella burnetii (cultures only)
	Crimean-Congo haemorrhagic fever virus
	Dengue virus (cultures only)
	Eastern equine encephalomyelitis virus (cultures only)
	Escherichia coli, verotoxigenic (cultures only)[1]
	Ebola virus
	Flexal virus
	Francisella tularensis (cultures only)
	Guanarito virus
	Hantaan virus

1 For surface transport (ADR) nevertheless, when the cultures are intended for diagnostic or clinical purposes, they may be classified as infectious substances of Category B.

Indicative examples of infectious substances included in Category A in any form unless otherwise indicated	
UN number and proper shipping name	**Micro-organism**
UN 2814 Infectious substance, affecting humans	Hantaviruses causing haemorrhagic fever with renal syndrome
	Hendra virus
	Hepatitis B virus (cultures only)
	Herpes B virus (cultures only)
	Human immunodeficiency virus (cultures only)
	Highly pathogenic avian influenza virus (cultures only)
	Japanese Encephalitis virus (cultures only)
	Junin virus
	Kyasanur Forest disease virus
	Lassa virus
	Machupo virus
	Marburg virus
	Monkeypox virus
	Mycobacterium tuberculosis (cultures only)[1]
	Nipah virus
	Omsk haemorrhagic fever virus
	Poliovirus (cultures only)
	Rabies virus (cultures only)
	Rickettsia prowazekii (cultures only)
	Rickettsia rickettsii (cultures only)
	Rift Valley fever virus (cultures only)
	Russian spring-summer encephalitis virus (cultures only)
	Sabia virus
	Shigella dysenteriae type 1 (cultures only)[2]
	Tick-borne encephalitis virus (cultures only)
	Variola virus
	Venezuelan equine encephalitis virus (cultures only)
	West Nile virus (cultures only)
	Yellow fever virus (cultures only)
	Yersinia pestis (cultures only)
UN 2900 Infectious substance, affecting animals only	African swine fever virus (cultures only)
	Avian paramyxovirus Type 1 – Velogenic Newcastle disease virus (cultures only)
	Classical swine fever virus (cultures only)
	Foot and mouth disease virus (cultures only)
	Lumpy skin disease virus (cultures only)

2 For surface transport (ADR) nevertheless, when the cultures are intended for diagnostic or clinical purposes, they may be classified as infectious substances of Category B.

Indicative examples of infectious substances included in Category A in any form unless otherwise indicated	
UN number and proper shipping name	**Micro-organism**
UN 2900 Infectious substance, affecting animals only	
	Mycoplasma mycoides – contagious bovine pleuropneumonia (cultures only)
	Peste des petits ruminants virus (cultures only)
	Rinderpest virus (cultures only)
	Sheep-pox virus (cultures only)
	Goatpox virus (cultures only)
	Swine vesicular disease virus (cultures only)
	Vesicular stomatitis virus (cultures only)

D. TRANSPORT OF BIOLOGICAL SUBSTANCES, CATEGORY B (UN3373)

Samples containing micro-organisms which do not cause life-threatening disease to humans or animals can be assigned to Category B and are assigned the identification number UN3373.

Some examples for Category B shipments are given below:

Typically a specimen with a high likelihood to contain pathogenic organisms shipped for disease diagnosis (e.g. confirmatory diagnosis of suspect or clinical cases, specimens for differential diagnosis, blood samples for classical swine fever or sheep pox diagnostics or throat samples from chickens for avian influenza) can be assigned to Category B. Although specimens can be shipped as Category B, pure cultures of the biological agent, such as classical swine fever or sheep pox (see list of micro-organisms of Category A) must follow the the requirements of Category A (UN 2900, infectious substances affecting animals only) due to the infectious nature of the specific organism.

Alternately, shipments of cultures of less pathogenic agents, e.g. bovine virus diarrhoea (BVD), *Salmonella enteritidis, Salmonella typhimurium* or *Listeria monocytogenes* can be assigned to Category B.

The following description of the packaging and labelling are a summary of the requirements for surface transport. For international shipment and air transport additional requirements do apply. The exact details can be found in packaging instruction P650 (see Section J).

1. Packaging

The triple packaging system continues to apply, including for local surface transport (description: see Section A. *Basic principles*).

The packaging shall be of good quality, strong enough to withstand the shocks and loadings normally encountered during carriage, including trans-shipment between vehicles or containers, as well as any removal from an overpack (several packages combined into a single shipment). The smallest overall external dimension shall be 10 × 10 cm.

For surface transport either the secondary packaging or the outer packaging must be rigid.

i) For air transport, the primary receptacle or secondary packaging must be capable of withstanding, without leakage, an internal pressure of 95 kPa in the range of –40°C to 55°C;

ii) for liquids: no primary receptacle shall exceed 1 litre and the outer packaging must not contain more than 4 litres;

iii) for solids: the outer packaging must not contain more than 4 kg. This restriction doesn't apply for body parts, organs and whole bodies. The three layer principle has to be adopted accordingly using appropriate packaging systems.

iv) the entire package should be able to withstand being dropped from a distance of 1.2 metres (4 feet) without damage to or leakage from the content.

2. Marking

The package must display the proper labelling to guarantee safe delivery in time at the correct destination.

Label is as follows:

i) Packages should be clearly labelled with the delivery address and sender's details with emergency contact details including named persons with telephone numbers for both the sender and the recipient.

II) Mark with the proper shipping name in letters at least 6 mm high: BIOLOGICAL SUBSTANCE, CATEGORY B (Figure 1)

iii) In addition to the shipping name the marking shown below (UN3373 diamond) is used for shipments of Category B infectious substances. If a biohazard label is not present on the primary or secondary packaging, it must be present on the outer packaging.

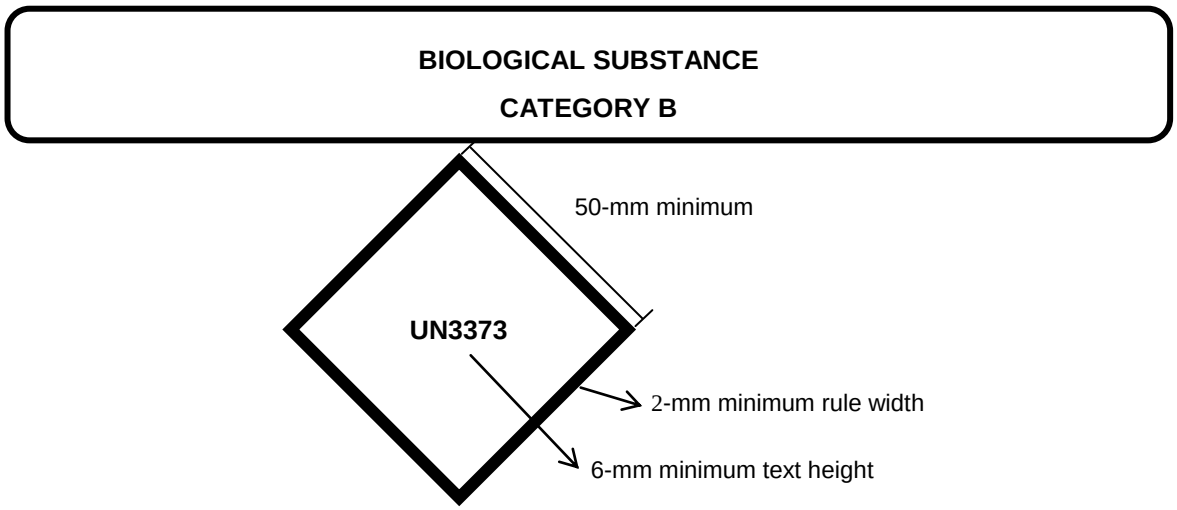

Figure 1: *UN3373 mark for the transport of Category B substances*

3. Documentation

There is no special documentation required for the shipment of Category B specimens for surface transport.

The information and case history sent with the specimens should be placed in a plastic bag between the secondary and the outer packaging and on the outside of the consignment. If a sample is shipped for diagnostic purposes further guidance on information to be sent with can be found in chapter 1.1.1.

For air transport only:

The documentation consists of the airway bill **for air transport** (form provided and filled out by sender or carrier), showing "UN 3373", the text "BIOLOGICAL SUBSTANCE, CATEGORY B" and the number of packages in the "Nature and Quantity of Goods" box, and / or equivalent documents for the transport by road.

E. OVERPACKS

"Overpack" is the term used when several packages are combined to form one unit and sent to the same destination by a single shipper. When refrigerants are used to protect contents, the overpacks may comprise insulated vessels or flasks. Whenever an overpack is used, the required marks and labels shown on the outer packaging must be repeated on the outermost layer of the overpack. This requirement applies to infectious substances in Categories A and B. Overpacks are also required to be marked with the word "overpack".

F. REFRIGERANTS

Refrigerants may be used to stabilise specimens during transport.

Ice or dry ice shall be placed outside the secondary receptacle. Wet ice shall be placed in a leak-proof container; the outer packaging or overpack shall also be leak-proof.

Dry ice must not be placed inside the primary or secondary receptacle because of the risk of explosions. A specially designed insulated packaging may be used to contain dry ice, typically a styropor or waxed-treated cardboard box to prevent leakage and maintain temperature. The packaging must permit the release of carbon dioxide gas if dry ice is used and the package (the outer packaging or the overpack) shall be marked “Carbon dioxide, solid” or “Dry ice” (see Section J). Dry ice is a dangerous good.

When using dry ice as refrigerant, the shipper must ensure that the class 9 safety label is shown on the upper half of each package with the number UN 1845. According to applicable transport regulations, only certified shippers are allowed to ship dry ice!

The secondary receptacle shall be secured within the outer package to maintain the original orientation of the inner packages after the refrigerant has melted or dissipated.

If liquid nitrogen is used as a refrigerant, additional requirements have to be followed according to the relevant regulations.

G. TRAINING

All personnel involved in the packaging, labelling and shipping of specimens should be appropriately trained and competent in packaging procedures and also knowledgeable of the shipping requirements and regulations.

H. EMERGENCY RESPONSES

Procedures for incidents such as spills or any other realistic and foreseeable emergencies should be part of the biorisk management system in order to response adequately to emergencies (see chapter 1.1.3).

I. SPECIAL CONSIDERATION FOR CITES

CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments with the aim to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

Some specimens to be transported from one country to another may be derived from species covered by CITES. Depending on the classification of the species, a CITES export permit or both export and import permits may be required and the appropriate documents have to be obtained. There is some variation of the requirements from one country to another and it is always necessary to check on the national laws that may be stricter.

Further information on CITES: http://www.cites.org/eng/disc/what.php

J. ADDITIONAL INFORMATION ON THE WORLD HEALTH ORGANIZATION, UNITED NATIONS AND OTHER INTERNATIONAL AND NATIONAL TRANSPORT GUIDANCE FOR INFECTIOUS SUBSTANCES

Further reading and information

WHO Guidance on regulations for the “Transport of Infectious substances” 2011–2012, covering transport regulations on national and international and air transport by different means:

http://www.who.int/ihr/publications/who_hse_ihr_20100801/en/index.html

Swiss Expert Committee on Biosafety: “Transport, import and export of substances consisting of or containing pathogenic or genetically modified (micro)organisms”; practical explanation on how to transport biological substances according to the specific dangerous goods transport regulations

http://www.efbs.admin.ch/en/transport/index.html

Additional information on the United Nations System for the Transport of Dangerous Goods

The United Nations dangerous goods web site provides comprehensive detail concerning the United Nations Recommendations on the Transport of Dangerous Goods. It also provides links to the modal agencies:

http://www.unece.org/trans/danger/danger.htm

The site below provides the full text of the United Nations Recommendations, which can be downloaded in PDF format. Readers wishing to see the text relating to the transport of infectious substances should download Part 2, Part 4 and Part 5 of the Recommendations:

http://www.unece.org/trans/danger/publi/unrec/rev17/17files_e.html

The site below provides the full text of the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) of 2009, and the amendments to ADR 2011, which entered into force on 1 January 2011, which can be downloaded in PDF format. Readers wishing to study the text relating to the transport of infectious substances should download Part 2 (2.2.62), Part 4 (search P620, P650) and Part 5:

http://www.unece.org/trans/danger/publi/adr/adr2011/11contentse.html

Contracting parties to the various conventions for the transport of dangerous goods can be found on a number of web sites:

Air	ICAO: http://www.icao.int/Pages/default.aspx
Rail	RID: http://www.otif.org/. RID is primarily for the countries of Europe, North Africa and the Middle East. There are a number of countries (mainly Eastern Europe and Asia that apply RID through the Organization for Cooperation of Railways (OSJD); details of RID membership can be found at http://www.otif.org/en/about-otif/addresses-and-useful-links/member-states.html
Road	ADR: http://www.unece.org/trans/danger/publi/adr/country-info_e.htm (lists competent authorities)
Sea	IMO: http://www.imo.org
Post	UPU: http://www.upu.int/

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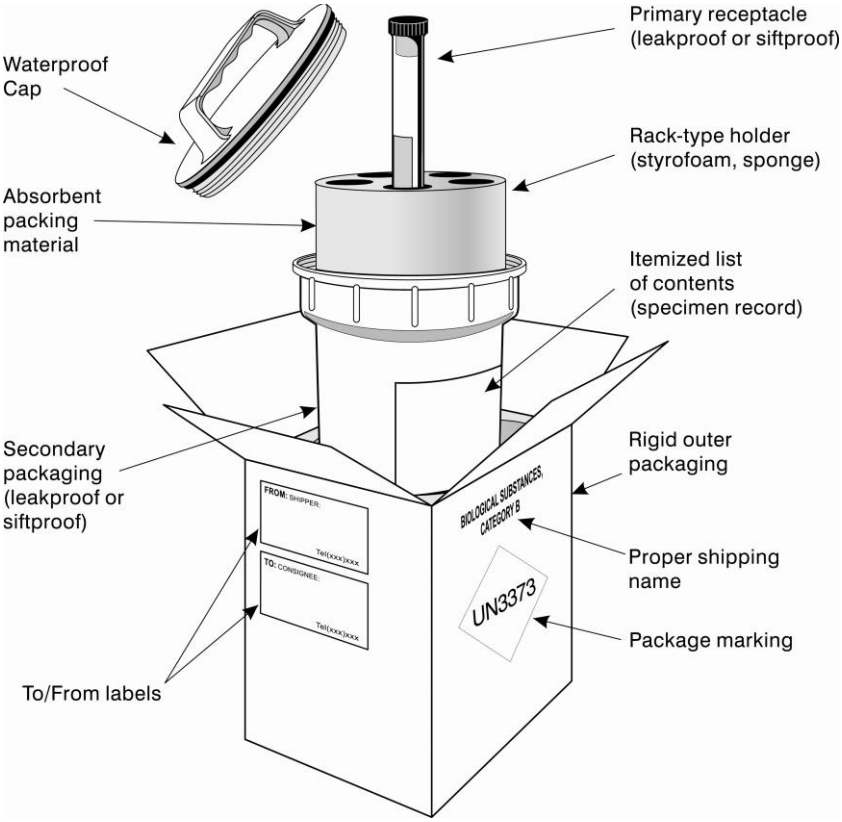
APPENDIX 1.1.2.1.

EXAMPLE OF THE TRIPLE PACKAGING SYSTEM FOR THE PACKING AND LABELLING OF CATEGORY B

Example of the triple packaging system for the packing and labelling of Category B, UN3373 infectious substances (Figure kindly provided by IATA, Montreal, Canada)



APPENDIX 1.1.2.2.

DECISION TREE FOR DECIDING ON THE TRANSPORT REQUIREMENTS OF A SAMPLE