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HAZMAT / DOT TRAINING FOR RADIOACTIVE MATERIAL SHIPPING AND TRANSPORTATION IN ACADEMIC & BIOTECHNOLOGY INSTITUTIONS (rev 1-12)

This module is intended to satisfy training requirements for personnel involved in preparing radioactive packages for shipment, in accordance with Department of Transportation (DOT) regulations. The relevant regulations are spelled out primarily in Title 49 Code of Federal Regulations (49 CFR), Parts 171, 172 and 173, and are designed to comply with the Hazardous Materials Transportation Act (HMTA). All sections of these regulations can be obtained online (for example, by googling “49 CFR” or “49 CFR 173.435”, or via the federal digital system, www.fdsys.gov).

Individuals who prepare radioactive material packages for transportation are required by the DOT to receive initial hazmat training, within 90 days of employment (or commencement of shipping duties), followed by recurrent training at least once every three years. There is a testing requirement that goes with this training, which can be met by successful completion of the accompanying quiz. Since the training certification is to be provided by the employer, the certificates we provide are worded accordingly. If you work at multiple facilities, appropriate certification from each employer must be on file. The training documentation form (page 18) may be used to keep track of DOT certification for all personnel at the facility.

Definitions and Descriptions

1. In DOT terminology, any material is defined as radioactive if both its exempt material activity concentration **and** exempt consignment activity limit exceed the values in §173.436. Table-2 provides values for some common radioisotopes. All radioactive materials fall under the purview of hazardous materials, subject to DOT regulations. An employee who, among other things, handles or prepares hazardous materials for transportation is considered a hazmat employee. Radioactive materials have been designated a hazard class of 7, and are referred to as ‘Class 7 (radioactive) materials’.

2. **Types of materials:** The vast majority of radioactive materials encountered in academia / research / biotechnology are classified as normal form, and include liquids, solids and gases. Materials that are not normal form are called special form of radioactive materials. These are specially encapsulated solid sealed sources, made to withstand rigorous integrity testing and are accompanied by an ‘IAEA Certificate of Competent Authority’ (also called ‘special form certificate’). Special form sources are encountered in industrial gauges, moisture probes, well logging equipment, etc. A radioactive article or instrument is an object or apparatus having radioactive material as a component part, requiring disassembly to get to the radioactive material. A survey meter with a dedicated ¹³⁷Cs button check-source attached to it qualifies as a radioactive instrument. A Surface Contaminated Object (SCO) is a solid object which by itself is not radioactive, but has radioactive material distributed on its surface. Based on the amount of fixed and removable contamination, these are classified into SCO-I and SCO-II objects. Low Specific Activity (LSA) material has limited specific activity (*i.e.*, activity per unit mass), and includes ores, mill tailings, consolidated wastes, etc. These are further classified into LSA-I, LSA-II and LSA-III, and are not encountered in routine academic / biotechnology operations.

3. The term **packaging** refers to the carton / container and any other packing / cushioning / spacing / shielding materials used to contain the radioactive material. A **package** means the packaging PLUS its radioactive contents. **Markings** mean descriptive names, identification numbers, instructions, cautions, weights, UN marks, etc. that are usually *printed* or handwritten on the outside of packagings. **Labels** are the diamond-shaped pieces (at least 100 mm²; e.g., Radioactive White-I, Radioactive Yellow-II and Radioactive Yellow-III; as specified in 49 CFR §172.436-440) that are typically *stuck* to the outside of packagings (although markings sometimes have to be stuck, and labels may sometimes be printed on the outside). ‘Danger, Do not load on passenger aircraft’ is a square, orange colored label, required on shipments that can only be loaded on cargo aircraft. An ‘Empty’ DOT label on a package means it is devoid of its radioactive contents, but not necessarily decontaminated. Such packages can have internal contamination of up to 0.099 μCi/100 cm² of beta/gamma/low toxicity alpha emitters.

Radioactive Material Type A Package, UN 2915

USA DOT 7A Type A

115 lbs UN 2910

UN 2911 RQ

From: _____

To: _____



Figure-1. Examples of common radioactive package **markings**. These include proper shipping names, package types, UN numbers, and From/To addresses, orientation markers, and weights. For excepted packages, the candy-striped UN number sticker is optional; a simple sign stating the UN number can be used instead.

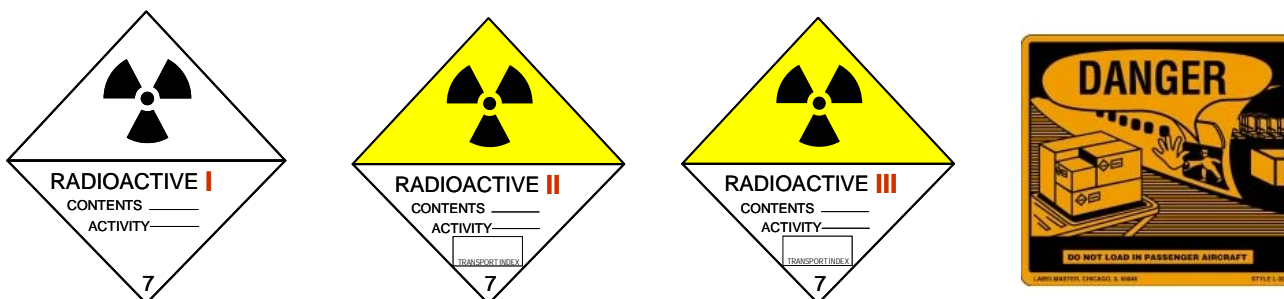


Figure-2. Examples of common radioactive package **labels**.

4. **Shipping Names:** All hazardous materials presented for transportation must have a proper shipping name and associated UN number. Below are a few examples of radioactive material shipping names that you may encounter. For a complete listing, see the Hazardous Materials Table, 49 CFR §172.101.

Shipping Name	ID. #
Radioactive material, excepted package - limited quantity of material	UN2910
Radioactive material, excepted package - Instrument or Article	UN2911
Radioactive material, excepted package - Empty packaging	UN2908
Radioactive material, Type A package	UN2915
Radioactive material, Type A package, special form	UN3332

Table 1. Shipping name examples

5. Paperwork to accompany packages: Most packages containing radioactive materials require Shipping Papers. These are comprised by the ‘Shipper’s Declaration for Dangerous Goods’ for air-transported packages, and ‘Bill of Lading’ for local / surface transport. Shipper’s Declaration for Dangerous Goods forms are available from carriers like FedEx Express (downloadable from www.fedex.com). See page 10 for a detailed description of how to fill in shipping papers, and pages 15-16 for examples. In addition, Emergency Response Information must accompany all shipments requiring shipping papers, and must include immediate hazards to health, risks of fire or explosion, immediate precautions to be taken, handling methods in case of fire or leaks/spills, first aid, and a 24 hour emergency number. See pages 13-14 for examples.

6. Excepted packages are packages that do not require labels and shipping papers, and have minimal marking requirements. The amount of radioactivity that is allowed in an excepted package is called a limited quantity (Table 2). Do not confuse excepted packages and limited quantities with the term *exempt quantities*, which have to do with how the NRC/agreement states define radioactive materials, and may not be directly applicable to DOT regulations.

Limited quantities can be calculated from tables §173.425 and §173.435. On these tables, normal form radioisotopes are quoted as A₂ values, while special forms are as A₁ values. Maximum A₁ and A₂ quantities are called Type A Quantities. A limited quantity of normal form solid material is $A_2 \div 1000$, and liquid material is $A_2 \div 10,000$. Amounts greater than Type A Quantities are called Type B Quantities.

7. Packaging types: Limited quantities can be shipped in packages that meet the general design criteria listed in §173.410 (the old terminology of a ‘strong, tight package’ is no longer valid). Any sturdy carton, at least 10 cm on its shortest dimension, without protruding surfaces, capable of retaining its integrity of containment and shielding during transit will meet the prescribed standards. The package must be easily handled, and its outer layers must avoid pockets or crevices where water might collect. All UN designated packages also meet these requirements. Radioactive material packages are for materials that do not qualify for excepted packages. Type A quantities require a Type A package, and quantities greater than Type A require a Type B(U) or B(M) package. Both these packages must meet strict design criteria, and the shipper must retain the required package test documentation.

8. A package containing Reportable Quantity (RQ) of radioisotopes needs a special notation on the carton and shipping papers (Table 2). Reportable quantities can be found in §172.101, Table 2 to Appendix A. A reportable quantity of radioactive material also makes it a hazardous substance (a sub-category of ‘hazardous material’). Generally, reportable quantities are far greater than limited quantities, but there are exceptions. For instance, ¹³¹I solid normal form limited quantity is 19 mCi, while its reportable quantity is only 10 mCi. Excepted packages containing RQs require shipping papers with minimal entries (see page 10). The same goes for radioactive materials that meet the standards of hazardous waste (defined as requiring a Hazardous Waste Manifest under EPA regulations, 40 CFR § 262).

Radioisotope	'Radioactive' by DOT Definition		'Radioactive' by NRC/Agreement State definition (Exempt Quantities)	Limited Quantities (for Excepted Packages)	Reportable Quantities	Type A Quantity limits (for Type A packages)
	exempt material activity concentration	exempt consignment activity limit				
¹⁴ C (liquid)	270 nCi/g	270 μCi	100 μCi	8.1 mCi	10,000 mCi	81,000 mCi
⁴⁵ Ca (liquid)	270 nCi/g	270 μCi	10 μCi	2.7 mCi	10,000 mCi	27,000 mCi
¹⁰⁹ Cd (liquid)	270 nCi/g	27 μCi	10 μCi	5.4 mCi	1000 mCi	54,000 mCi
⁵⁷ Co (solid)	2.7 nCi/g	27 μCi	100 μCi	270 mCi	100,000 mCi	270,000 mCi
¹³⁷ Cs (solid)	0.27 nCi/g	0.27 μCi	10 μCi	16 mCi	1000 mCi	16,000 mCi
³ H (liquid)	27 μCi/g	27 mCi	1000 μCi	110 mCi	1000 Ci	1100 Ci
¹²⁵ I (liquid)	27 nCi/g	27 μCi	1 μCi	8.1 mCi	10 mCi	81,000 mCi
¹³¹ I (solid)	2.7 nCi/g	27 μCi	1 μCi	19 mCi	10 mCi	19,000 mCi
¹³¹ I (liquid)	2.7 nCi/g	27 μCi	1 μCi	1.9 mCi	10 mCi	19,000 mCi
⁶³ Ni (solid)	2700 nCi/g	2700 μCi	10 μCi	810 mCi	100,000 mCi	810 Ci
³² P (liquid)	27 nCi/g	2.7 μCi	10 μCi	1.4 mCi	100 mCi	14,000 mCi
³³ P (liquid)	2700 nCi/g	2700 μCi	100 μCi	2.7 mCi	1000 mCi	27,000 mCi
³⁵ S (liquid)	2700 nCi/g	2700 μCi	100 μCi	8.1 mCi	1000 mCi	81,000 mCi

Table 2. Examples of *normal form* quantities encountered in academic / biotech programs.

9. Transport Index (TI) is the maximum dose rate (measured in mR/hr) at 1 meter (3.3 feet) from the surface of a package. It is a unitless number, rounded *up* to the first decimal place (e.g., a dose rate of 1.57 mR/hr = TI of “1.6”; 0.32 mR/hr = “0.4”; 0.06 mR/hr = “0.1”). Dose rates ≤ 0.05 mR/hr are considered to have a TI of zero.

10. A radioactive **placard** is a specific sign (49 CFR §172.556) that needs to be posted on the sides and ends of vehicles carrying shipments with a ‘Radioactive Yellow III’ label, or material shipped as **LSA or SCO Exclusive use**. These are not applicable to activities routinely encountered in research / biotechnology.

11. A note on **security awareness** pertaining to radioactive material shipments from an academic / research / biotechnology facility: Most radioactive materials used in these settings represent a minimal human health risk because of the small amounts routinely handled in laboratories. The primary risk with all such materials is their potential use in ‘dirty bombs’ or ‘weapons of mass disruption’, characterized by panic, media attention and economic (cleanup) costs, rather than health effects. Follow the same security precautions with shipping packages as you would with any radioactive materials in your lab: All material must be secured unless under the direct and constant supervision of an authorized individual. Hand over shipping packages only to authorized FedEx (or other shipping company) representatives / workers. If you discover any security breach (unknown / unauthorized individuals taking possession of the source; or missing source / package), notify facility security and the Radiation Safety Officer immediately.

Types of packages

A shipping package containing radioactive material will fall under one of the following four categories:

1. An excepted package
- 2 a. A 'Radioactive White I' package
- b. A 'Radioactive Yellow II' package
- c. A 'Radioactive Yellow III' package

How do you decide on the type of package to use? Measure the dose rate on the external surfaces of the package, before sealing up.

If the maximum dose rate is less than or equal to 0.5 mR/hr, ship it as:

- Excepted package if below Limited Quantity
- Excepted package with abbreviated shipping papers if Limited Quantity, but Reportable Quantity or Hazardous Waste.
- White I package if more than Limited Quantity

If the maximum surface dose rate is greater than 0.5 mR/hr, ship it as:

- Yellow II or Yellow III package, based on Table-3

Type of package	Surface dose rate in mR/hr	Dose rate at 1 meter in mR/hr	Label required ?	Transport Index required ?	Type of packaging
Excepted package (Limited Quantity)	≤ 0.5	N/A	No	No	Meets standards in § 173.410
Radioactive material	≤ 0.5	≤ 0.05	White I	No	Type A or Type B
Radioactive material	> 0.5 but ≤ 50	> 0.05 but ≤ 1.0	Yellow II	Yes (0.1 to 1.0)	Type A or Type B
Radioactive material	> 50 but ≤ 200	> 1.0 but ≤ 10.0	Yellow III	Yes (1.0 to 10.0)	Type A or Type B
Radioactive material, exclusive use	> 200 but ≤ 1000	> 10.0	Yellow III	Yes (> 10.0)	Type A or Type B

Table 3. Package types. Page 17 contains a comprehensive flow-chart with the same information.

If the combination of surface and 1-meter dose rates qualify the package for two types of labels, then the HIGHER category label applies. For instance, a package with surface dose rate 60 mR/hr (a Yellow-III qualification) and 1-meter dose rate 0.6 mR/hr (a Yellow-II qualification) needs a Yellow-III label. Similarly, a surface 40 mR/hr (Yellow-II qualification) and 1-meter 1.5 mR/hr (Yellow-III qualification) package needs a Yellow-III label.

If you are shipping qualified limited quantity material with external surface dose rate <0.5 mR/hr, it is *your choice* whether to ship it as an excepted package or a White-I package. With the excepted package, you have the advantage of not trying to find a Type-A carton (with accompanying documentation), satisfying marking requirements, completing shipping papers, and affixing radioactive labels or security seals. Therefore, using a large enough shipping carton and applying the principles of time, distance and shielding to reduce surface dose will save you from the exacting requirements of preparing a 'radioactive' package. The same principles can be employed to enable the use of an excepted package instead of a Yellow-II package.

Combinations of radionuclides

Calculations need to be done if you want to ship different radioisotopes in one package. These are described in §173.433, and involve setting up unity equations with the known activities on the numerator and table values on the denominator, making sure both have the same units. If the sum of these fractions is ≤ 1, the activities or limits tested are met. If the sum of the fractions is > 1, the activities or limits are exceeded.

Table values may be RQs (§172.101, Table 2 to Appendix A) if you want to determine if the combination is a reportable quantity; or A₁ or A₂ values (§173.435) if you want to determine if the combination qualifies for limited quantities or Type-A quantities or packages. Here are two examples:

Q. Is this collection of liquid vials a limited quantity?: 500 µCi ³²P, 1 mCi ¹⁰⁹Cd, 350 µCi ⁴⁵Ca, 100 µCi ³⁵S.

A. Unity equation of activities ÷ limited quantity values, all in mCi:

$$\frac{0.5}{1.4} + \frac{1}{5.4} + \frac{0.35}{2.7} + \frac{0.1}{8.1} = 0.357 + 0.185 + 0.130 + 0.012 = \mathbf{0.684}$$

Sum is less than 1.0, therefore, this is a limited quantity combination.

Q. Is this combination a reportable quantity?: solid ⁶³Ni 20 mCi, liquid ¹²⁵I 800 µCi, and liquid ³³P 3 mCi.

A. Unity equation of activities ÷ RQ values, all in mCi:

$$\frac{20}{100,000} + \frac{0.8}{10} + \frac{3}{1000} = 0.0002 + 0.08 + 0.003 = \mathbf{0.0832}$$

Sum is less than 1.0, therefore, the combination is not a reportable quantity.

Returning sealed sources to the manufacturer

Returning sealed sources (special form or normal form) to the manufacturer or vendor requires a ‘return authorization number’, which is supplied when you originally purchase the source (or upon request). This allows for a one-to-one exchange between a used and a new source. In addition, you are strongly encouraged to save the original carton and packaging materials in which the source arrived, and use it for the return shipment. This carton, with minor modifications, will meet the standards and specifications for the return shipment. The suppliers also provide a return kit that contains instructions, labels, addresses and other items required for shipment of that particular source. Note that in these circumstances you can consider the manufacturer as the shipper, with you acting as the shipper’s agent, merely preparing the package for shipment. Under such an arrangement, you (as package the preparer) do not need to have Type-A package documentation in your files.

Type-A packages have to go through rigorous testing (water spray, drop, puncture, and crush), and Type-A documentation paperwork is generally held by the manufacturer. This documentation is not merely for the container, but includes the manner in which the specific material is packed / cushioned / braced / supported in the container. It is important to prepare a shipment exactly as it was intended to be packed.

Package preparation guidelines

- (a) Secure the source firmly in its shielded container or inner packaging.
- (b) Perform a wipe test of the inner container and save the results for your records.
- (c) Prepare a ‘Caution Radioactive Material’ label containing the trefoil radiation symbol, isotope name, amount and reference date, and affix it to the outside of the shielded container or inner packaging. In case you are shipping radioactive material without a shielded container or inner packaging, there are further requirements depending on the type of package (see page 7).
- (d) Pack the shielded container in the shipping carton and seal it, applying strong packing tape to all the seams. If you are returning a sealed source to the manufacturer, they generally require a copy of the calibration certificate for the source and evidence of the last satisfactory leak test, performed within the last 6 months, showing that the removable contamination was less than 0.005 µCi (*i.e.*, 5x10⁻³ µCi, or 5x10⁻⁶ mCi, or 5 nCi, or 11,100 dpm). This paperwork should be included along with the source.
- (e) Perform a wipe test on the carton (outer container), and ensure that trigger levels (section 1d below) are not exceeded. Measure the radiation dose rate (in mR/hr, using a survey meter) on all surfaces of the carton (including the top and bottom), and at 1 meter from the package. Save the results for your records.

The highest dose rate measured will determine how the package will need to be marked and labeled for shipping. *Remember to make a copy of all completed documents (especially packing slip and shipping papers) for your files. These need to be retained for a minimum of 375 days after shipment.*

1. Excepted packages

If the package contains limited quantity of radioactive material, *and* the maximum external dose rate is **less than or equal to 0.5 mR/hr**, the package can be shipped as an excepted package. If the material is a Reportable Quantity or hazardous waste, there are additional shipping paper requirements (page 10).

(a) The package must be **marked UN2910** (for limited quantity material), or **UN2911** (for limited quantity instruments or articles), or **UN2908** (for empty packaging). Alternatively, a commercially available sticker such as '**Excepted Package Limited Quantity of Material UN2910**' may be used. The marking must be at least 0.5" high, and placed on a vertical surface of the package. Completely cover or obliterate previously printed markings on the carton, such as 'Radioactive Material Type A Package, UN2915, USA DOT 7A Type A', etc.

As a general rule, make sure that all required markings on the carton are clear, legible, and not obstructed or covered by packaging tape or other attachments. Leave a clear area around the markings to make them stand out.

(b) Remove or obliterate existing Radioactive Material White or Yellow labels on the carton. In addition, if there is no shielded container or inner packaging inside the carton, the word "Radioactive" must also be marked on the outside of the carton (if you already affixed the 'caution radioactive materials' sticker on the inner packaging, disregard this requirement).

(c) No security seal is required on the package. No White-I, Yellow-II or Yellow-III labels are required. No trefoil symbols are required. No shipping papers (Shipper's Declaration for Dangerous Goods) are required, except for RQs and hazardous wastes. See note-2 under section 2(e) below for details.

(d) Ensure that removable contamination on the carton exterior is less than 2200 dpm/100 cm² for beta, gamma and low toxicity alpha emitters (or 220 dpm/100 cm² for other alpha emitters). This wipe test is a requirement for excepted packages. You need to record the number, but need not quote it on any DOT paperwork.

(e) Emergency response information is not required for excepted packages. However, if instructed (and provided) by the manufacturer, use it. Affix an envelope on the top of the carton (the return kit contains a self-stick clear envelope). Insert the following into the envelope:

(i) Emergency Response Information applicable to a UN2910 package, which will be used in mitigating an incident involving the material. This should include, at a minimum, immediate hazards to health, risks of fire or explosion, immediate precautions to be taken, handling methods in case of fire or leaks/spills, first aid, and 24 hour emergency numbers (see example on page 13). This information can also be printed from the *Emergency Response Guide 2008*, a PDF document obtainable by googling "ERG 2008". Guides 161-166 (PDF document pages 270-281) deal with radioactive material packages.

Note: It is required that the emergency telephone number be manned continuously (while the package is in transit) by a person knowledgeable about the source being shipped and in emergency response, or has immediate access to a person who possesses such information. Pager numbers, answering services, call-back numbers and voice mail are not acceptable. Most manufacturers quote their own 800 numbers for this purpose. If your source return papers provide a blank space for the telephone number, check with the manufacturer if you can use their number. *Chemtrec* is another organization that provides a 24 hour responder program and a toll-free contact number. Details are at www.chemtrec.org.

(ii) A completed packing list or source return form, if / as required by the consignee.

(f) Address the package and specify the return authorization number, in any. If shipping by FedEx Express, use a standard FedEx airbill. Packaging: Check 'Other'. Does this shipment contain dangerous goods?: Check 'Yes. Shipper's declaration not required' (unless this is an RQ shipment). Call FedEx for a pickup at your location (do not deposit in a FedEx drop box or deliver to a shipping agent). Aside from FedEx, UPS also transports excepted packages.

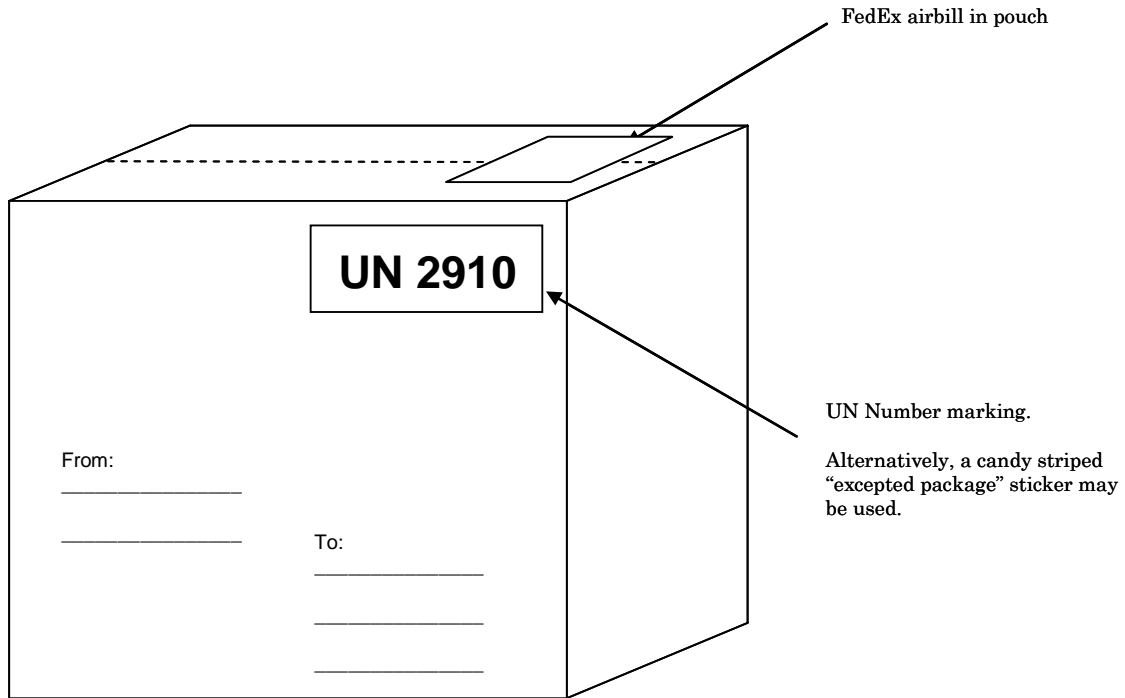


Figure-3. Example of an excepted package containing limited quantity material. Only one UN number marking is required. The From and To address are not marking requirements, but are recommended.

2. Radioactive-material packages

Irrespective of whether the package contains limited quantity of radioactive material or not, if the maximum external dose rate on the package is **greater than 0.5 mR/hr**, the package must be shipped as a radioactive-material package. At a minimum, a Type-A package is required.

(a) Marking requirements: The following markings must appear on the exterior of the carton:

(i) The package type “USA DOT 7A Type A” (or TYPE B, as applicable).

(ii) The DOT shipping name, such as “Radioactive Material Type A package UN2915”. Shipping names ending with ‘**n.o.s**’ can no longer be used.

(iii) Name and address of the shipper and receiver. These are in addition to the address provided in the FedEx airbill. Highway shipments that will not be transferred to another motor carrier do not need a From / To address.

(iv) If the material is a Reportable Quantity (thereby making it a ‘hazardous substance’), the letters “RQ” must precede the shipping name.

(v) If the gross weight of the package is greater than 110 pounds (50 Kg), the weight must be marked.

(vi) Two ↑ symbols on opposite sides are required if the package contains a liquid.

(vii) A type B package requires a radiation trefoil symbol, at least 0.8” diameter.

(b) A security seal is required on the package (if not available, prepare your own seal- a sticker with the words “Security Seal – notify shipper of broken”- and tape it across the seam of the carton).

(c) Labeling requirements: Affix the appropriate ‘Radioactive Material’ diamond shaped label, based on the external dose rates listed in the table on page 4. **Two of these labels** are required per package, placed on opposite vertical sides of the carton. Enter the name of the radioisotope and its current activity in SI units (kBq, MBq, GBq) in the space provided on the labels. Values in traditional units (μ Ci, mCi, Ci) may be added optionally in parenthesis following the SI units. Enter the transport index on ‘Yellow II’ and ‘Yellow III’ labels.

Useful conversions: $1\mu\text{Ci} = 37 \text{ kBq}$; $1 \text{ mCi} = 37 \text{ MBq} = 0.037 \text{ GBq} = 0.000037 \text{ TBq}$; $1 \text{ Ci} = 37 \text{ GBq}$

(d) Only materials intended for use in research, medical diagnosis or treatment, and having a transport index less than 3.0 can be loaded on passenger aircraft. For applicable Yellow II and yellow III packages that cannot be loaded on passenger aircraft, affix two black & orange “Danger – Do not load in passenger aircraft” labels (§172.448) on opposite vertical sides of the carton.

Note that all applicable markings / labels /stickers should be placed together on a given vertical side. Make sure that all markings and labels are clear, legible, and not obstructed or covered by packaging tape or other attachments. Leave a clear area around the markings and labels to make them stand out.

(e) Affix an envelope on the top of the carton (the FedEx airbill plastic envelope can be used). Insert the following into the envelope

(i) Emergency Response Information applicable to the UN designated package, which will be used in mitigating an incident involving the material. This should include, the proper shipping name and hazard class number, immediate hazards to health, risks of fire or explosion, immediate precautions to be taken, handling methods in case of fire or leaks/spills, first aid, and 24 hour emergency numbers.

This information can also be printed from the *Emergency Response Guide 2008*, a PDF document obtainable by googling “ERG 2008”. Guides 161-166 (PDF document pages 270-281) deal with radioactive material packages. Examples of emergency response forms are shown on pages 13-14

(ii) A completed packing list or source return form, if / as required by consignee.

(iii) A completed ‘shipper’s declaration for dangerous goods’ (also called ‘shipping paper’). See examples on pages 15-16 For additional help with this form, call FedEx at 1-800-463-3339, option 81. Blank forms and instructions are also available at www.fedex.com, and more specifically at <http://www.fedex.com/us/services/pdf/ShippersDecColumnsColorPrinter.doc>

The shipper’s declaration cannot be handwritten (except for the signature). If the FedEx candy-striped downloadable form is used, it must be typed and printed in color, with the candy stripes appearing in red. Make at least four copies, three for FedEx and the remaining for your files.

Items on the declaration include:

1. From and To addresses
2. Transport details (‘passenger and cargo aircraft’ or ‘cargo aircraft only’)
3. Shipment type (‘radioactive’)
4. Proper shipping name (e.g., ‘Radioactive Material, Type A Package’). If the amount is a reportable quantity, the letters “RQ” must precede the shipping name
5. Class or division number (‘7’)
6. UN number (e.g., ‘UN2915’)
7. Quantity and type of packaging (e.g., ‘Co-57, solid resin, 1 type A package, ___ MBq, ___ mCi’)
8. Packing instructions (e.g., Yellow II, TI = ___, DIM = ___ x ___ x ___ cm). Denote gross weight if >110 lbs.
9. Authorization (Special form certificate number, if applicable)
10. 24 hour Emergency telephone number, name, addresses, and signature
11. Shipper’s certification: “This is to certify that the above named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation” or equivalent. Also, “I declare that all the applicable air transport requirements have been met”
12. Medical / research certification (if applicable): “This shipment contains radioactive material intended for use in, or incident to, research, of medical diagnosis or treatment”. Packages meeting this requirement can be transported by either passenger or cargo aircraft, and do not need the orange ‘cargo aircraft only’ label.

Note 1: It is required that the emergency telephone number provided in the emergency response form and shipping papers be manned continuously (while the package is in transit) by a person knowledgeable about the source being shipped and in emergency response, or has immediate access to a person who possesses such information. Pager numbers, answering services, call-back numbers and voice mail are not acceptable. Many source manufacturers allow you to use their 800 numbers for this purpose; contact the consignee to find out if this service is available to you. *Chemtrec* is another organization that provides a 24 hour responder program and a toll-free contact number. Details are at www.chemtrec.org. Otherwise, provide your facility’s emergency response number.

Note 2: Shipping papers for excepted packages containing RQs require only these entries: The shipping name (“RQ, Radioactive Material, Excepted Package – Limited Quantity of Material”); Class (7), UN Number (UN2910); Quantity (e.g., 1 Box of samples), 24 hour emergency telephone number, shipper’s certification, and signature.

(f) Address the package and specify the return authorization number. If shipping by FedEx Express, use a standard FedEx airbill. Packaging: Check 'Other'. Does this shipment contain dangerous goods?: Check 'YES, as per attached shipper's declaration'. Call FedEx for a pickup at your location (do not deposit in a FedEx drop box or deliver to a shipping agent).

Remember to make a copy of all completed documents (especially packing slip, Emergency Response Information and shipping papers) for your files. These need to be retained for a minimum of 375 days after shipment.

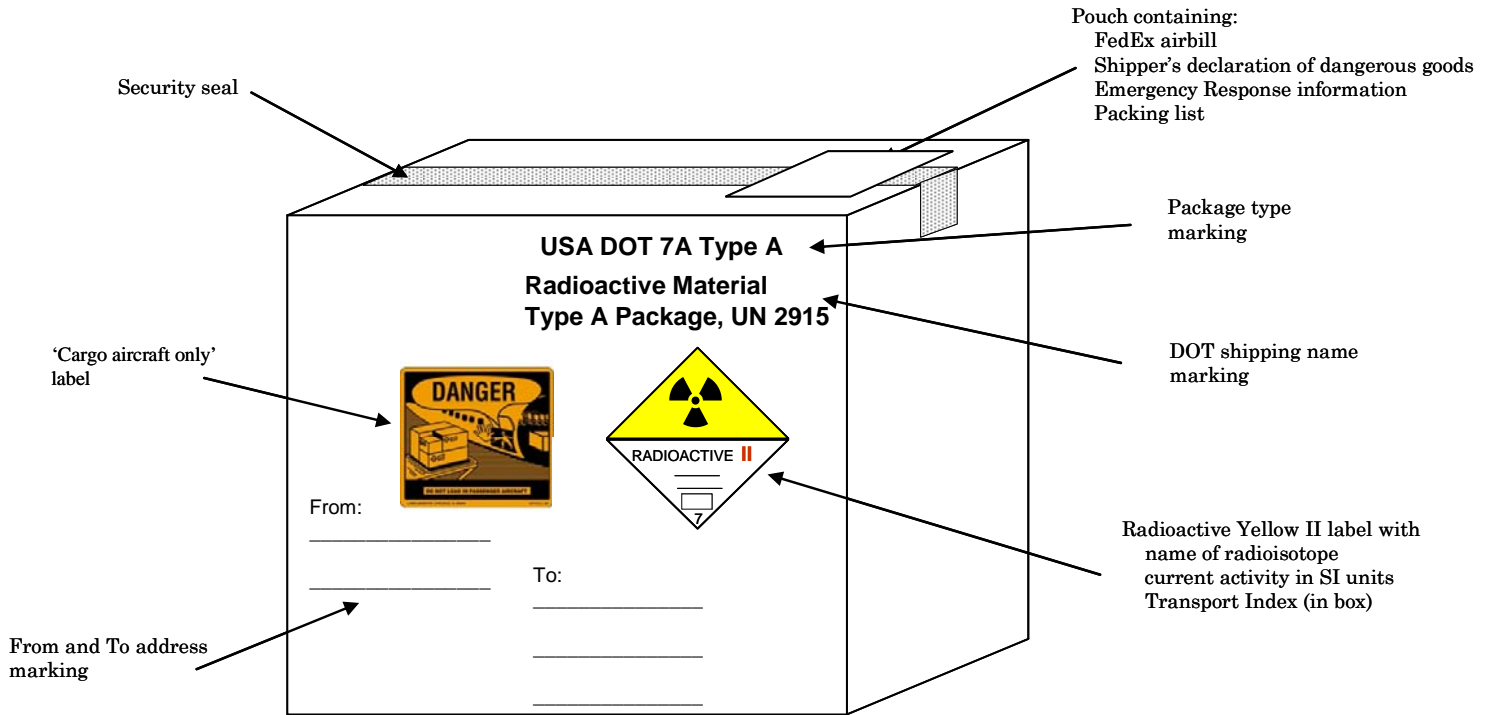


Figure-4. Example of a Yellow-II package, containing type-A quantity solid radioactive material, weighing less than 110 lbs . The markings only need to appear on one side of the package; labels need to appear on two opposite vertical sides.

Ground Transportation of radioactive materials

If you want to transport radioactive materials by yourselves, instead of shipping them via FedEx or other qualified carriers, you need a special radioactive materials license. The vast majority of licenses DO NOT allow such transport. Transporting radioactive materials without proper license authorization is a violation of your license conditions.

You can, however, put together packages for surface transportation by authorized carriers. The rules governing surface transport of radioactive materials are generally same as those outlined in the previous sections. Excepted package / White I / Yellow II / Yellow III rules apply with respect to dose rates, marking and labeling requirements. Here are a few caveats pertaining to surface transportation of radioactive materials:

While the transporters do not need to carry calibration and leak test information (for sealed sources; these need to be in your files), they do need to carry the appropriate shipping papers and emergency response information. A Bill of Lading is an acceptable type of shipping paper for ground transportation. The shipping papers and emergency response papers must be within the immediate reach of the driver, or mounted in a holder on the driver's side door.

Yellow-II and Yellow-III packages are not to be carried in compartments occupied by people. For Yellow-III shipments that are in non-exclusive use vehicles (this includes carriers like FedEx and UPS), the maximum allowed package dose rate is 200 mR/h (surface) and 10 mR/h (1-meter); the aggregate transport index for all packages must not exceed 50 (at which point they will not pick up any more packages). Yellow-III packages with surface dose rates exceeding 200 mR/h, and 1-meter dose rates exceeding 10 mR/h must be transported as exclusive use shipments (*i.e.*, sole use, by a single consignor) in closed vehicles, with the following provisions: The external dose rate on the package does not exceed 1000 mR/h; the package does not move around during transportation; there are no loading / unloading operations during the transportation; external surface dose rates on the vehicle (including top and bottom) do not exceed 200 mR/h; dose rate at 2.2 meters does not exceed 10 mR/h; dose rate in a normally-occupied space (*eg.*, the driver's cab) does not exceed 2 mR/h (unless the occupants are radiation workers wearing dosimetry badges); the driver has a Commercial Driver's License (CDL), and carries specific written safety instructions. See 49 CFR § 173.441 for details.

Radioactive Placards: Vehicles carrying Radioactive Yellow-III packages, highway-route controlled quantities of radioactive materials, as well as exclusive use shipments of LSA (low specific activity) and SCO (surface contaminated objects) need placarding. Placards need to be displayed on all 4 vertical sides of the vehicle, and must be clear of obstructions. See 49 CFR § 172.500 to 560 for details.



Figure-5. Example of a 'radioactive' placard

EMERGENCY RESPONSE INFORMATION

1. **PROPER SHIPPING NAME AND HAZARD CLASS:**
Radioactive material, Type A Package, Hazard Class 7, UN2910.
2. **IMMEDIATE HAZARDS TO HEALTH:**
None. Radiation presents minimal risk to transport workers, emergency response personnel, and the public during transportation accidents.
3. **RISK OR FIRE OR EXPLOSION:**
None. Radioactivity does not change flammability or other properties of the materials. Some of these materials may burn, but none of them ignites readily.
4. **IMMEDIATE PRECAUTIONS:**
Keep unnecessary people away. Isolate hazard area to deny entry. Uninjured persons or equipment with suspected contamination should be detained or isolated. Delay cleanup until instructions are received from Radiation Authority.
5. **EMERGENCY FIRE MEASURES:**
Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide adequate protection. Maintain surveillance until Radiation Authorities arrive.
6. **HANDLING FIRE MEASURES:**
Do not touch damaged packages or spilled material. Small liquid spills: Cover with sand, earth or other noncombustible absorbent material. Do not attempt clean-up operations. Maintain controlled area until Radiation Authorities arrive.
7. **FIRST AID:**
The emergency number 911 should be used as ordinarily prescribed. Ambulance and hospital personnel should be informed about possible low-level radioactive contamination or other radiological conditions. Use first aid treatment according to the nature of the injury.
8. **EMERGENCY NUMBER:**
Chemtrec: 1-800-424-9300 (24 hours).

Emergency Response form example 2

EMERGENCY RESPONSE INFORMATION

Radioactive material, Type-A Package, UN2915

(low to High Level Radiation)

ERG-2008, Guide 163

Call Acme Chemical Lab at 555- 123-4567 for Emergency Assistance**POTENTIAL HAZARDS****HEALTH**

1. Radiation presents minimal risk to transport workers, emergency response personnel, and the public during transportation accidents. Packaging durability increases as potential hazard of radioactive content increases.
 2. Undamaged packages are safe. Contents of damaged packages may cause higher external radiation exposure, or both external and internal radiation exposure if contents are released.
 3. Type A packages (carton, drums, boxes, articles, etc.) identified by "Type A" by marking of the packages or by shipping papers contain non-life endangering amounts or radioactivity. Partial released might be expected if "Type A" packages are damaged in moderately severe accidents.
 4. Radioactive White-I labels indicate radiation levels outside single, isolated, undamaged packages are very low (less than 0.005 mSv/h (0.5 mrem/h).
 5. Radioactive Yellow-II and Yellow-III labeled packages have higher radiation levels. The transport index (TI) on the label identifies the maximum radiation level in mrem/h one meter from a single, isolated, undamaged package.
6. Water used in fire fighting may cause radioactive contamination to spread.

FIRE OR EXPLOSION

1. Some of these materials may burn, but most do not ignite readily.
2. Radioactivity does not change flammability or other properties of materials.
3. If possible, small fires should be extinguished with CO₂ or dry chemical.

PUBLIC SAFETY

1. Priorities for rescue, life-saving, first aid, and control of fire and other hazards are higher than the priority for measuring radiation levels.
2. Radiation Authority must be notified of accident conditions. Radiation Authority is usually responsible for decisions about radiological consequences and closure of emergencies.
3. should a spill or leak or radioactive material occur, isolate spill or leak area immediately for at least 25 to 50 meters (80 to 160 feet) in all directions. Stay upwind. Keep unauthorized personnel away. Detain or isolate uninjured persons or equipment suspected to be contaminated; delay decontamination and cleanup until instructions are received from Radiation Authority.

PROTECTIVE CLOTHING

1. Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide adequate protection against internal radiation exposure, but not external radiation exposure.

EVACUATION

Large Spill: Consider initial downwind evacuation for at least 100 meters (330 feet).

Fire: When a large quantity of this material is involved in a major fire, consider an initial evacuation distance of 300 meters (1000 feet) in all directions.

SPILL OR LEAK

1. Do not touch damaged packages or spilled material.
2. Damp surfaces on undamaged or slightly damaged packages are seldom an indication of packaging failure. Most packaging for liquid content has inner containers and/or inner absorbent materials
 3. Cover liquid spill with sand, earth or other noncombustible absorbent material.

FIRST AID

1. Medical problems take priority over radiological concerns.
2. Use first aid treatment according to the nature of the injury. Do not delay care and transport of a seriously injured person.
3. Apply artificial respiration if victim is not breathing. Administer oxygen if breathing is difficult.
 4. In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. Injured persons contaminated by contact with released material are not a serious hazard to health care personnel, equipment or facilities.
5. Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination.

EXAMPLES of SHIPPER'S DECLARATION FOR DANGEROUS GOODS

NATURE AND QUANTITY OF DANGEROUS GOODS						
Dangerous Goods Identification				Quantity and Type of Packaging	Packaging Inst.	Authorization
Proper Shipping Name	Class or Div.	UN or ID No.	Subsidiary Risk			
<i>Radioactive Material, Type A package</i>	7	UN 2915		<i>¹²³I, Solid Inorganic Salt. 1 Type A package 0.3 GBq (8 mCi)</i>	<i>Yellow-II TI = 0.3 DIM 35 x 45 x 100 cm</i>	
<i>RQ, Radioactive Material, Excepted Package, Limited Quantity Material</i>	7	UN 2910		<i>1 Box of samples</i>		
<i>RQ, Radioactive Material, Type A package, Special Form</i>	7	UN 3332		<i>¹³⁷Cs, Solid Metal. 185 MBq (10 mCi). ²⁴¹Am, Solid Metal. 1.48 GBq (40 mCi) All packed in one Type A Package</i>	<i>Yellow-II TI = 0.8 DIM 25 x 35 x 55 cm</i>	<i>²⁴¹Am Special Form Cert. No. 9999</i>

SHIPPER'S DECLARATION FOR DANGEROUS GOODS

(Provide at least three copies to the airline)

Shipper: _____

Air Waybill No. _____
Page 1 of 1 Pages
Shipper's Reference Number: **T1245**

Consignee: **208 524 5300**
INT ISOTOPES IDAHO, INC
4137 COMMERCE CIRCLE
IDAHO FALLS ID US 83401

FedEx

Two completed and signed copies of this Declaration must be handed to the operator.

WARNING
Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties. This Declaration must not, in any circumstances, be completed and/or signed by a consolidator, a forwarder, or an IATA cargo agent.

TRANSPORT DETAILS
This shipment is within the limitations prescribed for: (delete non-applicable)
 PASSENGER AND CARGO AIRCRAFT CARGO AIRCRAFT ONLY
Airport of Departure: _____
Airport of Destination: _____

Shipment type: (delete non-applicable)
 NON-RADIOACTIVE RADIOACTIVE

NATURE AND QUANTITY OF DANGEROUS GOODS							
Dangerous Goods Identification					Quantity and type of packaging	Packing Inst.	Authorization
Proper Shipping Name	Class or Division	UN or ID No.	Packing Group	Subsidiary Risk			
RADIOACTIVE MATERIAL, TYPE A PACKAGE	7	UN 2915			C0-57, SOLID/RESIN 1 TYPE A PACKAGE X 370 MBq (10 MCI)	II YELLOW TI .5 DIM 68 X 78 X 15 CM	

Example

Additional Handling Information

Emergency Telephone Number **800-424-9300**

I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to applicable International and National Governmental Regulations. I declare that all the applicable air transport requirements have been met.

Name/Title of Signatory: _____
Your Name and Title
Place and Date: _____
City, State
Signature: _____
Your Signature
(see warning above)

FOR RADIOACTIVE MATERIAL SHIPMENT ACCEPTABLE FOR PASSENGER AIRCRAFT, THE SHIPMENT CONTAINS RADIOACTIVE MATERIAL INTENDED FOR USE IN OR INCIDENT TO RESEARCH, MEDICAL DIAGNOSIS, OR TREATMENT.

EXAMPLES of BILL OF LADING

Your Company's Letterhead
BILL OF LADING

SHIPPER: ABC Biotechnology, Inc. TO: Special Project Labs
1 Madame Curie Dr. 200 Fermi Pl.
Anytown, MA 01234 Somewhere, MA 04321

DATE: 1/1/2005

No. of Pack-ages	Basic Description	Label	Transport Index	Form	Radio-nuclide	Activity
2	Radioactive Material, Type A package, 7, UN2915	Yellow -II	0.5	Solid (inorganic Salt)	P-32	370 MBq (10 mCi)
1	RQ, Radioactive Material, Excepted Package, Limited Quantity of Material, 7, UN2910					
2	RQ, Radioactive Material, Type A package, 7, UN3332	Yellow -II	0.6	Solid (metal)	Am-241	1.11 GBq (30 mCi)
1	Radioactive Material, Type A package, 7, UN 2915	White I	N/A	Liquid	Tl-201	37 MBq (1 mCi)

This is to certify that the above-named materials are properly classified, described, packaged, marked, labeled and placarded, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation. I declare that all the applicable air transport requirements have been met.

Signature: _____ Date: _____

Toll Free Emergency Number: 1-800-123-4567

BILL OF LADING

SHIPPER: Healthy Hospital TO: Acme Radiopharmaceuticals
1234 East West Street 4321 West East Street
Anytown, MA 01234 Anywhere, MA 04321

DATE: 1/1/2005

Radioactive Material, Type A Package, 7, UN2915

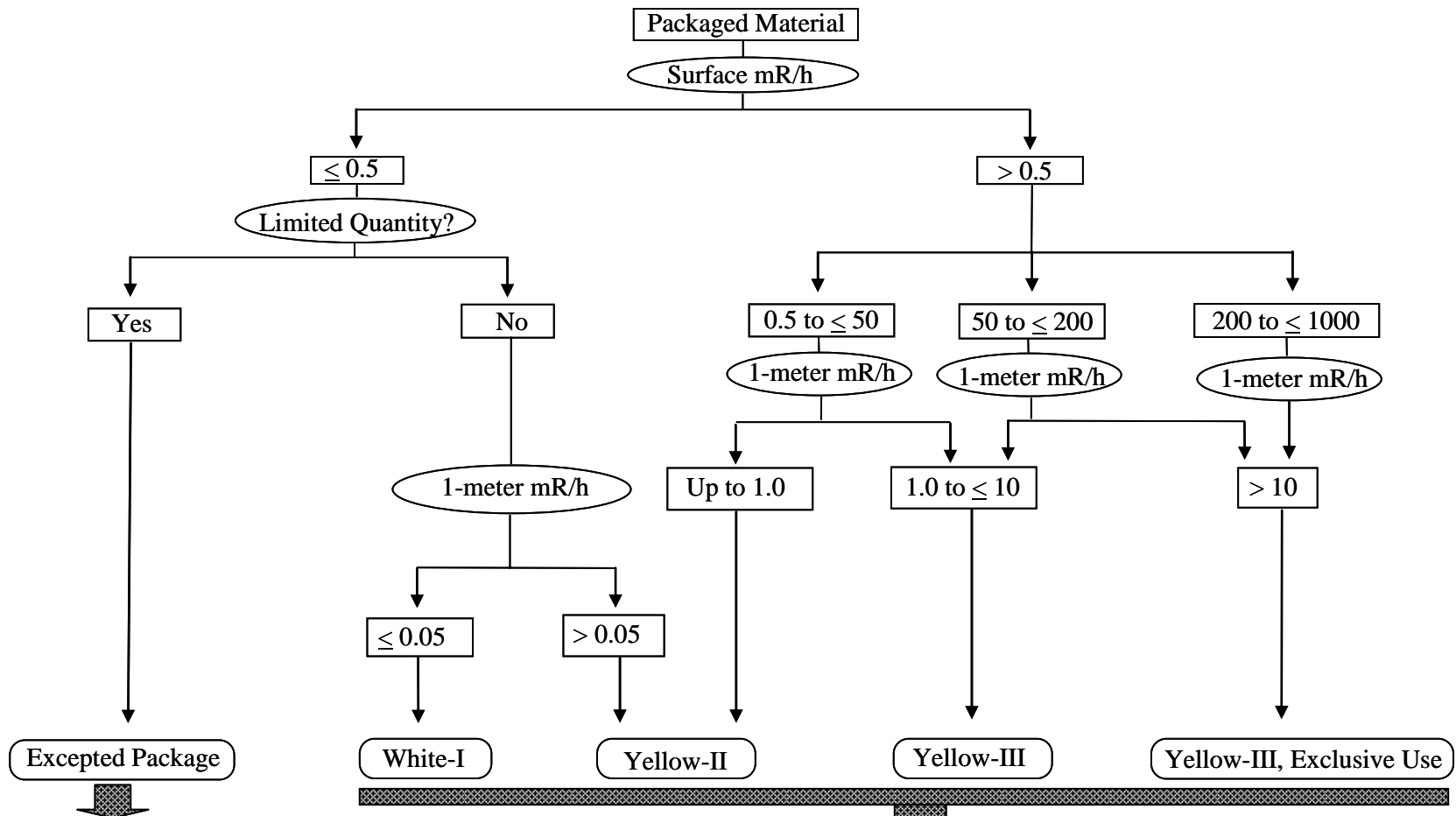
Radionuclide: ⁹⁹Mo
Form: Sodium Molybdate, Solid
Activity: 4.25 GBq
Category: White I ___ Yellow II X Yellow III ___

Transport Index: 0.2
Container Type: A

This is to certify that the above-named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation. I declare that all the applicable air transport requirements have been met.

Signature: _____ Date: _____

24 Hour Emergency Number: 123-555-1234 or 1-800-123-4567



Packaging: 173.410 standards / UN designated
 Marking: "UN2910" or "Excepted Package Limited Quantity of Material UN2910";
 "Radioactive" on outside of inner packaging; if no inner pkging., on the outside of carton
 Labeling: None
 Security Seal: None
 Shipping papers: None (except for RQ or Haz. Waste)

Packaging: Type A (if < A₁ or A₂ quantity) or Type B (if > A₁ or A₂ quantity)
 Marking: DOT shipping name / UN number / Type A or Type B / consignor and consignee's Name & Address / If applicable: RQ / Weight / USA / trefoil symbol / 'Up' Arrows
 Labeling: Radioactive White-I / Yellow-II / Yellow-III / TI as applicable
 Security Seal: Required
 Shipping Papers: Required

