Topics in Radiation Safety:
HAZMAT / DOT TRAINING FOR NUCLEAR MEDICINE TECHNOLOGISTS

1.0 ASRT Continuing Education Credit

Third Edition, May 2026
With updated quiz

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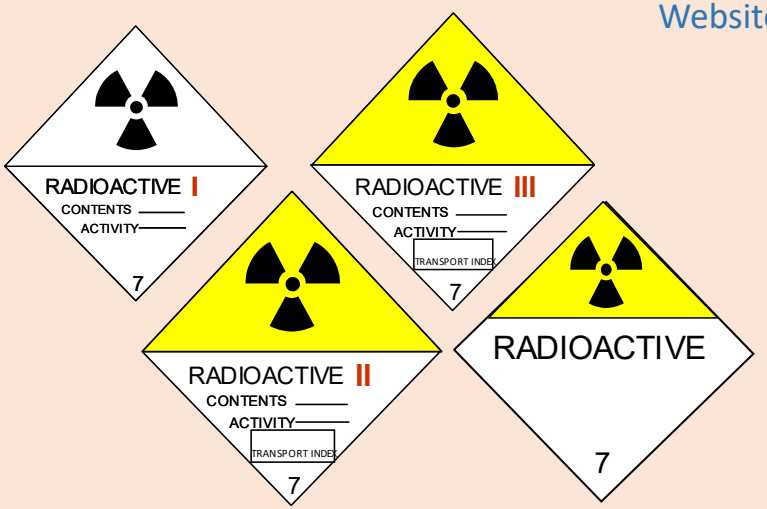

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Second: August 2023

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This tutorial is approved for 1 ASRT Continuing Education Unit (CEU).
It is accompanied by an 'open book' quiz.
Recommend that you download the tutorial for personal use, and refer to it while answering questions.

No Artificial Intelligence was used in the generation of this tutorial or the accompanying quiz

Training Requirements

This module is intended to satisfy training requirements for personnel involved in receiving and preparing radioactive packages for shipment, typically receiving patient doses and sealed sources from a radiopharmacy vendor, or returning spent doses and expired sealed sources to the radiopharmacy or the manufacturer.

The training is in accordance with US 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, https://www.govinfo.gov/.

Nuclear medicine technologists 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 such duties), followed by recurrent training at least once every 3 years (49 CFR 172.704).

International Air Transport Association (IATA) requires recurrent training every 2 years, but this does not apply to the transportation of radioactive materials within the United States. You only have to meet the 3-year recurrent training requirement as long as you do not ship outside the United States.

There is a testing requirement that goes with this training, which can be met by successful completion of the accompanying quiz.

Certification of DOT training is to be provided by the licensee (i.e., employer), and not the trainer. Therefore, the name of your licensee must be listed as the certifier in your DOT documentation. If you work for multiple licensees, appropriate certification from each licensee must be on file. If you work for additional new licensees during a 3 year period after certification, contact F.X. Masse Associates to obtain certification documents listing all current licensees; the date on the certificate will be the date you took the initial quiz for the 3-year period.

Per 49 CFR 172.704, DOT training includes 4 aspects:

(1) General awareness / familiarization training - on regulatory requirements of 49 CFR
(2) Function-specific training – pertaining to sealed source returns by FedEx, or spent dose returns via vendor's courier.
(3) Safety training – covering emergency response information
(4) Security awareness training – primarily the need to secure packages, or have them under constant surveillance.

Definitions and Descriptions

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 49 CFR 173.436. If both these values are below limits, the package may be shipped without regard to DOT regulations.

Table-1 (page 7) 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'. Almost all radioactive materials encountered in nuclear medicine (including dose calibrator calibration sources, flood sources and patient doses) are classified as normal form.

Materials that are not normal form are called special form. These are encapsulated solid sealed sources made to withstand rigorous testing, and are accompanied by an 'IAEA Certificate of Competent Authority' (also called 'special form certificate'). ^{241}Am positioning sources in some older gamma cameras sometimes qualify as special form.

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. Examples: smoke detector containing ^{241}Am, luminous watch dial containing ^{226}Ra.

The term packaging refers to the cardboard box, carton or container and any other packing, cushioning, spacing, shielding materials used to contain the radioactive material. A package means the packaging PLUS its radioactive contents.

Security Seal refers to a means of securing a package such that any tampering or attempts to open it become evident. At a minimum, handwritten or printed labels that say 'security seal', applied at the seam of a package and covered with clear tape are accepted by FedEx.

Shipping Names: All radioactive materials presented for transportation must have a proper shipping name and associated UN number.

Radioactive material, excepted package - limited quantity of material	UN2910
Radioactive material, Type A package	UN2915
Radioactive material, excepted package - Instrument *or* Article	UN2911
Radioactive material, Type A package, special form	UN3332

Examples of proper shipping names and their UN Numbers

Markings mean descriptive names, identification numbers, instructions, cautions, weights, UN marks, etc. that are usually *printed* or handwritten on the outside of packages. Markings must be of a sharply contrasting color to the background; must not be obstructed by other attachments or labels; and located away from other markings or wordings that would reduce their effectiveness. One set of markings per package is sufficient.

Radioactive Material
Type A Package, UN 2915

USA DOT 7A Type A

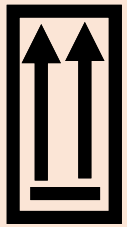
UN 2910

UN 2911

RQ **115 lbs**

From: _____
_____

To: _____
_____
_____



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.

Labels are the diamond-shaped or square pieces, at least 10 cm long, that are typically *stuck* to the outside of packages. If required on a package, labels must be affixed on two opposite vertical sides of the package.

RADIOACTIVE WHITE-I Label: The Entire label has white background, and the 'I' is in red.

RADIOACTIVE YELLOW - II Label: Top half of the triangle is in yellow, and the 'II' is in red.

Hazard Class

RADIOACTIVE YELLOW - III Label: Top half of the triangle is in yellow, and the 'III' is in red.

These can be handwritten:

- Name of isotope(s)
- Activity in SI units (kBq, MBq, GBq etc). Activity in traditional units may be added optionally.
- Transport Index value (no units)

CARGO AIRCRAFT ONLY Label: Black, with orange background. Required on sealed source returns that go by air.

Only materials for research, medical diagnosis or treatment, and having a Transport Index less than 3.0 can be loaded on passenger aircraft

EMPTY

EMPTY Label:
Black lettering, at least 1 inch high, on white background, at least 6 inches (15.2 cm) square.
An 'Empty' DOT label 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 cm^2 of beta/gamma/low toxicity alpha emitters.

Examples of radioactive package **labels.**

Placards are the diamond-shaped signs required on all 4 sides of vehicles that carry one or more packages that have a Radioactive Yellow-III label, or material shipped as LSA (Low Specific Activity) – Exclusive Use or SCO (Surface Contaminated Object) - Exclusive Use. These are not applicable to sealed source activities routinely encountered in nuclear medicine.

Excepted packages are suitable for shipping Limited Quantity (LQ) materials. They do not require labels and shipping papers (unless they contain Reportable Quantities, or RQ), and have minimal marking requirements. (see Table-1, page 7 for Limited Quantities and Reportable Quantities). If multiple radioisotopes with Limited Quantities are shipped in a container, the total activity in the container must not exceed the lowest LQ value of those isotopes. See more details on page 23)

Limited quantities can be calculated from 49 CFR 173.425 and §173.435. On these tables, normal form radioisotopes are quoted as A_2 values, while special forms are as A_1 values. Maximum A_1 and A_2 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.

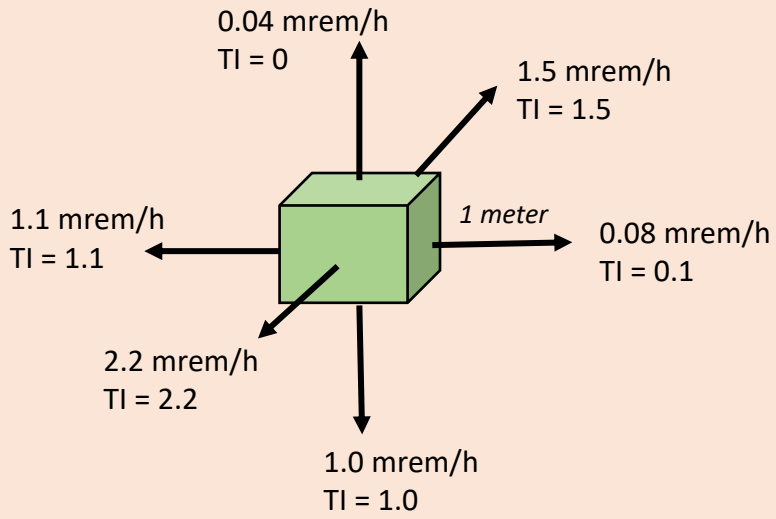
Do not confuse excepted packages and limited quantities with the term *exempt quantities*, which have to do with how the NRC / agreement states define radioactive materials, and may not be directly applicable to DOT regulations. For instance, NRC/states consider 10 µCi of ^{133}Ba and ^{137}Cs; and 100 µCi of ^{57}Co, ^{99m}Tc and ^{201}Tl as exempt quantities, while these quantities are still considered radioactive materials under the DOT definition.

Excepted Packages with limited quantities can be shipped in cartons / cases that meet the general design criteria listed in 49 CFR 173.410 (previously, the term 'strong, tight package' was used; this term 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. Although all UN designated packages (e.g., Type-A package) also meet these requirements, it is not mandatory to use a Type-A container for Excepted Packages.

Radioactive material packages are for materials that do not qualify for excepted packages. Type A quantities require a Type A package. Quantities greater than Type A require a Type B(U) or B(M) package; such Type B packages, as well as Industrial Packages (IP-1, IP-2, IP-3) and Type C packages also are not of use in nuclear medicine operations, and not covered in this tutorial.

A package containing Reportable Quantity (RQ) of radioisotopes (Table-1, page 7; and published in 172 CFR 101, Table 2 to Appendix A) needs an 'RQ' marking on the carton and shipping papers. 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, ^{131}I 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. 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).

Transport Index (TI) is the maximum dose rate out of all sides, measured in mrem/h, 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 mrem/h = TI of "1.6"; 0.32 mrem/h = "0.4"; 0.06 mrem/h = "0.1"). Dose rates ≤ 0.05 mrem/h are considered to have a TI of zero. The TI value is written on Yellow II and Yellow III package labels, as well as on shipping papers for those packages.



In this example, the highest dose rate = 2.2 mrem/h. Therefore, the TI to report in shipping papers and on the package label is 2.2

Table-1. Examples of *normal form* quantities encountered in nuclear medicine

Radioisotope (arranged alphabetically)	'Radioactive' by NRC/Agreement State definition (Exempt Quantities)	'Radioactive' by DOT Definition		Limited Quantity limits (for Excepted Packages)*	Reportable Quantity (RQ)	Type A Quantity limits (for Type A packages)
		Exempt material activity concentration	Exempt consignment activity limit			
	µCi	**nCi/g**	**µCi**	**mCi**	**mCi**	**mCi**
^{133}Ba (solid)	10	2.7	27	81	10,000	81,000
^{14}C (solid)	100	270	270	81	10,000	81,000
^{14}C (liquid)	100	270	270	8.1	10,000	81,000
^{57}Co (solid)	100	2.7	27	270	100,000	270,000
^{137}Cs (solid)	10	0.27	0.27	16	1000	16,000
^{18}F (liquid)	1000	0.27	0.27	1.6	1,000,000	16,000
^{67}Ga (liquid)	100	2.7	27	8.1	100,000	81,000
^{153}Gd (solid)	10	2.7	270	240	10,000	240,000
^{123}I (liquid)	100	2.7	270	8.1	10,000	81,000
^{131}I (solid)	1	2.7	27	19	10	19,000
^{131}I (liquid)	1	2.7	27	1.9	10	19,000
^{111}In (liquid)	100	2.7	27	8.1	100,000	81,000
^{177}Lu (liquid)	100	2.7	270	1.9	100,000	19,000
^{233}Ra (liquid)	not specfied	2.7	2.7	0.019	1000	190
^{117m}Sn (liquid)	0.1	2.7	27	1.1	100,000	110,000
^{99m}Tc (liquid)	100	2.7	270	11	100,000	110,000
^{201}Tl (liquid)	100	2.7	27	11	1,000,000	110,000
^{133}Xe (gas)	100	27.0	0.27	270	1,000,000	270,000
^{90}Y (liquid)	10	27	2.7	0.81	10,000	8,100

*higher activity requires radioactive material (White or yellow) package

Shipper's Declaration of Dangerous Goods, commonly called Shipping Paper is a form required for Radioactive White and Yellow labeled packages. On the forms used by FedEx, Items on the declaration include the following. An example of a completed form is provided on the next page.

1. From (shipper) and To (consignee) addresses
2. Transport details ('passenger and cargo aircraft' or 'cargo aircraft only'), airport of departure and destination
3. Shipment type (cross out 'non-radioactive')
4. UN number (*e.g.*, 'UN2915')
5. 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
6. Class or division number ('7')
7. Packing Group and Subsidiary Risk (leave blank)
8. Quantity and type of packaging. Activity in SI units mandatory, and can be followed optionally with activity in traditional units (*e.g.*, Co-57, solid resin, 1 Type A package, ___ MBq, ___ mCi)
9. Packing instructions (*e.g.,* Yellow II, TI = ___, DIM = (L) ___ (W) x ___ (H) x ___ cm). Denote gross weight if >50 kg (110 lbs).
10. Authorization (Special form certificate number, if applicable)
11. 24 hour Emergency telephone number, name, addresses, date and signature. The person whose name appears in this section must have valid DOT training certification. The telephone number does not necessarily have to be this person's.
12. Additional handling information (leave blank, unless necessary)
13. Airbill number from FedEx label; page 1 of 1, and optional shipper's reference number (can be return authorization number)

Note on Excepted Packages containing Reportable Quantities: Shipping papers for EPs containing RQs require these entries: 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, and signature.

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.

IMPORTANT: 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. Typically, a nuclear medicine technologist's cellphone number can be used as emergency contact. Make sure you carry the cellphone with you at all times until you receive confirmation that the package has been delivered. *Chemtrec* is an organization that provides a 24 hour responder program and a toll-free contact number, if you set up an account with them. Details are at https://www.chemtrec.com/

Example of completed Shipping Paper for sealed source return to Eckert & Zeigler

SHIPPER'S DECLARATION FOR DANGEROUS GOODS (Provide at least two copies to the airline)

Shipper: Technologist's name, Facility Address

Air Waybill No. 12345678 — Page 1 of 1 Pages — Shipper's Reference Number (optional)

Consignee: Eckert & Ziegler Isotope Products, 800 N. Keystone Street, Burbank CA 91504 USA

FedEx Federal Express

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

TRANSPORT DETAILS

This shipment is within the limitations prescribed for: (delete non-applicable)

PASSENGER AND CARGO AIRCRAFT XXXX | CARGO AIRCRAFT ONLY XXXX

Airport of Departure: BOS

Airport of Destination: LAX

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.

Shipment type: (delete non-applicable) XXXXXXXXXXXXXX | RADIOACTIVE

NATURE AND QUANTITY OF DANGEROUS GOODS

Dangerous Goods Identification: Proper Shipping Name	Class or Division	UN or ID No.	Packing Group	Subsidiary Risk	Quantity and type of packaging	Packing Inst.	Authorization
Radioactive Material, Type A Package	7	UN2915			SEE EXAMPLES →		

Additional Handling Information

Emergency Telephone Number 012-112-1122

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.

Name/Title of Signatory: Tech's Name, CNMT

Place and Date: Boston , MA, 1/1/2020

Signature (see warning above): *Signature*

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

FedEx M-1421 1/99 LOGOS# 2041730848

Quantity and type of packaging	**Packaging Inst.**
For a dose calibrator vial source	
^{57}Co, Solid Resin, 1 Type A package, 33.3 MBq (0.9 mCi)	Yellow-II, TI = 0.8, DIM (L) 40 x (W) 40 x (H) 40 cm
For a gamma camera flood source	
^{57}Co, Metallic Salt solid, 1 Type A package, 18.5 MBq (0.5 mCi)	Yellow-II, TI = 0.5, DIM (H) 78 x (W) 10 x (H) 59 cm
For a PET scanner calibration source, gross weight >50 kg	
Ge-68, Epoxy Solid, 1 Type A package, 5.4 MBq	Yellow-II, TI = 0.5, DIM (L) 41 x (W) 41 x (H) 56 cm, 70 kg
For a gamma camera flood source on a form that has only one column:	
UN2915, Radioactive Material, Type P Package, 7 // Co-57, Metallic Salt solid, 1 Type A package x 18.5 MBq // Yellow-II, TI = 0.5, DIM (H) 78 x (W) 10 x (H) 59 cm	

Hint: Use the same wordings as used by the source manufacturer on the incoming package

Types of packages: A shipping package containing radioactive material will fall under one of the following five categories:

1. Excepted package, Limited Quantity
2. **a**. Radioactive White I package
   b. Radioactive Yellow II package
   c. Radioactive Yellow III package
   d. Radioactive Yellow III Exclusive Use package

How do you decide on the type of package to use? Measure the dose rate on all 6 external surfaces of the package.

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

- Excepted package if below Limited Quantity
- Excepted package with abbreviated shipping papers if below Limited Quantity, but is Reportable Quantity or hazardous waste.
- Radioactive White I package if more than Limited Quantity

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

- Radioactive Yellow II or Yellow III package, based on Table-2 below
- You are not expected to encounter a Yellow III Exclusive Use shipment in nuclear medicine.

Table-2. Types of Packages

Type of package	Surface dose rate (mrem/h)	Dose rate at 1 meter (mrem/h)	Label required ?	Transport Index required ?	Shipping Paper required?	Type of packaging
Excepted package (Limited Quantity)	< 0.5	N/A	No	No	No (unless RQ)	Meets standards of 49 CFR 173.410
Radioactive material	< 0.5	< 0.05	White I	No	Yes	Type A*
Radioactive material	> 0.5 but < 50	> 0.05 but < 1.0	Yellow II	Yes (0.1 to 1.0)	Yes	Type A
Radioactive material	> 50 but < 200	> 1.0 but < 10.0	Yellow III	Yes (1.0 to 10.0)	Yes	Type A
Radioactive material, Exclusive Use	> 200 but < 1000	> 10.0	Yellow III	Yes (> 10.0)	Yes	Type A

Removable contamination limits on all package surfaces: 2,200 dpm/100 cm^2 (scalable, e.g., 6,600 dpm/300 cm^2) for beta, gamma and low toxicity alpha emitters; and 220 dpm/100 cm^2 for other alpha emitters.

* If Type A quantities shipped

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 mrem/h (a Yellow-III qualification) and 1-meter dose rate 0.6 mrem/h (a Yellow-II qualification) needs a Yellow-III label. Similarly, a surface 40 mrem/h (Yellow-II qualification) and 1-meter 1.5 mrem/h (Yellow-III qualification) package needs a Yellow-III label.

If you are shipping qualified limited quantity material with external surface dose rate <0.5 mrem/h, 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.

Returning sealed sources to the manufacturer requires a 'return authorization (RA) number', which is supplied by the manufacturer when you originally purchase the source, or upon request. This allows for a one-to-one exchange between a used and a new source. Vendors will not take back sources for which they do not specifically provide the return authorization number; therefore contact them for returning additional / unrelated sources (with a possible payment).

Please 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 vendor will also provide (for a charge) a return kit that contains instructions, labels, addresses and other items required for shipment of that particular source.

Type-A packages have to go through rigorous testing (see below), and Type-A documentation paperwork is generally held by the manufacturer. This documentation is not merely for the box or 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. Merely printing the words 'Type A Package' on a cardboard box does not make it a Type A Package.

Type A packages are certified after they pass a water spray test (for at least 1 hr, simulating rain at 2 inches/h); drop test (1-4 foot drop in most damaging orientation); compression test (with a force 5 times the package weight for at least 24 hrs) and penetration test (using a 13.2 lbs, 1.25 inch diameter steel rod dropped from at least 3.3 feet).

Image source: US DOT Radioactive Material Regulations Review

General Guidelines for Package Receipt (applicable to patient doses and sealed sources)

(a) For routine radiopharmaceutical dose deliveries, hand delivered by the vendor's courier: Provide instructions to the radiopharmacy describing how the delivers are to be made, both during working hours and during off-hours. These instructions should be provided annually.

For occasional deliveries, such as sealed sources from the manufacturer: Inform the receiving department to have the FedEx driver deliver the package directly to the department, or make arrangements for pickup at the receiving department or receiving dock.

(b) Once the package is received in the department, it is no longer considered 'in shipment', and must be formally checked-in within 3 hours of receipt, or after start of the working day, for off-hour deliveries. Check-in procedure involves:

(i) External dose rate survey on all six sides of the package at 1 meter (for White I, Yellow II and Yelow III packages), and along the surfaces (for all packages), and comparing against allowable ranges (page 10).

(ii) Wipe test for removable contamination on the external surfaces, using wipe test paper and moderate force. Wipe an area of 100 cm^2 (approximately the size of a 3" x 5" index card) over all 6 sides of the package. Measure the wipe to ensure that removable contamination is less than 2,200 dpm/100 cm^2. If a larger surface are is wiped, scale the allowable limit proportionately (e.g., 6,600 dpm in 300 cm^2 wiped).

(c) Open the package, remove the packing slip, compared aglint the ordered radiopharmaceutical. Open the inner package, and wipe test gain to ensure that none of the contents has leaked. Record the incoming shipment using your recordkeeping mechanism – either electronic, or paper based. For sealed sources, fill out the top section and **incoming shipment survey** section of the **Sealed Source Receipt and Transfer Record**; example shown on next page.

(d) If the package and inner packaging is cardboard and no to be reused: After confirming that it is not contaminated, deface or remove all labels and signage indicating the presence of radioactivity (all trefoil symbols, all words 'radioactive'), and discard as regular trash. If the cardboard box is to us re-used to send back a spent source, cover up all 'radioactive' wordings and labels with paper or tape, and store securely in a dry location until needed.

If the package is radiopharmaceutical dose to be picked up by the vendor's courier, set it aside to be packed with spent syringes in their syringe pigs.

Example of properly completed record

SEALED SOURCE RECEIPT AND TRANSFER RECORD

(To be saved in your files along with Certificate of Calibration and Shipping Papers)

Nuclide: ^{57}Co Type: Vial *(vial, flood, needle, rod, line, button, or other - specify)*

Mfr: E&Z Model # SRV-057-5M Serial # 2510-25-18

Assay: 5.128 mCi Date of Assay: 5/1/2020

This date and activity (assay) are the ones listed on the source label (not the activity you may have measured when you received the source)

INCOMING SHIPMENT SURVEY

(Complete this section upon receipt of the above source)

This source was: ☑ received from manufacturer or vendor; ☐ transferred from _____ *(check one)* *(specify)*

Date of receipt: 5/25/20 Received by: Joe Technologist

GM Package Surveys -

Surface: 0.7 mR/hr

1 meter: 0.08 mR/hr *(3.3 feet)*

Wipe Test Results -

Outer container: <2200 dpm/100 cm^2

Inner container: <2200 dpm/100 cm^2

Surveys and wipe tests below trigger levels? ☑ YES ☐ NO

Instrument used: Ludlum model # 14C *(14-C, 3, etc)*, S/N 251483 with a 44-88 *(44-88, 44-9)* probe, S/N 521486

This section is filled out on the day of receipt of the source listed

OUTGOING SHIPMENT SURVEY

(Complete this section when the above source is returned / transferred)

This source is being: ☑ returned to manufacturer or vendor; ☐ transferred to _____ *(check one)* *(specify)*

Date of shipment: 3/1/22 Sent by: Jane Technologist

GM Package Surveys -

Surface: 0.2 mR/hr

1 meter: 0.05 mR/hr *(3.3 feet)*

Wipe Test Results -

Outer container: <2200 dpm/100 cm^2

Inner container: <2200 dpm/100 cm^2

Type of outgoing package: *(check one)* ☑ Excepted ☐ White-I ☐ Yellow-II ☐ Yellow-III

Instrument used: Ludlum model # 3 *(14-C, 3, etc)*, S/N 862176 with a 44-9 *(44-88, 44-9)* probe, S/N 968281

Remember to make a copy of the: ☑ *calibration certificate;* ☑ *packing slip;* ☑ *emergency response information;* ☐ *shipping papers (if applicable)*

N/A

This section is filled out on the day the above source is sent out. Common mistake: entering data for an incoming source, and another outgoing source, on the same record sheet.

Trigger levels:	Package dose rate must not exceed: Surface, mR/hr	1 meter, mR/hr
Excepted Package	0.5	N/A
White-I package	0.5	0.05
Yellow-II package	50	1.0
Yellow-III package	200	10

Package wipe tests must not exceed 2200 dpm / 100 cm^2
(Trigger level for beta, gamma and low toxicity alpha emitters)

Wiping a larger surface area will proportionately increase the trigger level;
For instance: 6600 dpm / 300 cm^2

If survey or wipe results exceed trigger levels, notify the Radiation Safety Officer immediately

General Guidelines for Preparing a Package for shipment

Part 1: *Sealed Source Returns via FedEx*

(a) Secure the source firmly in its shielded container or inner packaging.

(b) 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 (this label is part of the return kit).

(c) Pack the shielded container in the shipping carton (the same way you received the new source), and include:

(i) a copy of the calibration / technical data sheet for that source, and

(ii) a copy 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).

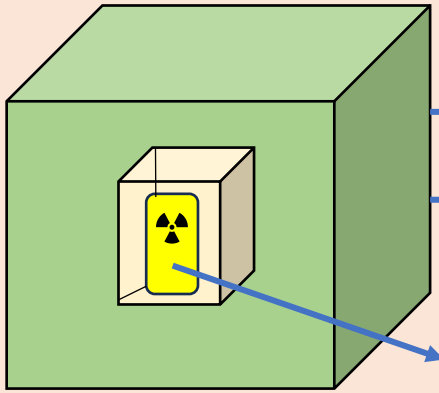
(d) Perform a wipe test on the carton (outer container), and ensure that trigger levels (Table 2, Page 10) are not exceeded. Measure the radiation dose rate (in mrem/h, using a GM survey meter) on all surfaces of the carton, including the top and bottom, and at 1 meter from the package. Record the wipe test and survey numbers on the **Outgoing Shipment Survey** section of the **Sealed Source Receipt and Transfer Record**; example shown on previous page.

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.

(e) The highest dose rate measured on the surface and at 1 meter will determine how the package will need to be marked and labeled for shipping:

(a) Excepted Package
(b) Radioactive Material Package

Package prepared and presented for shipment



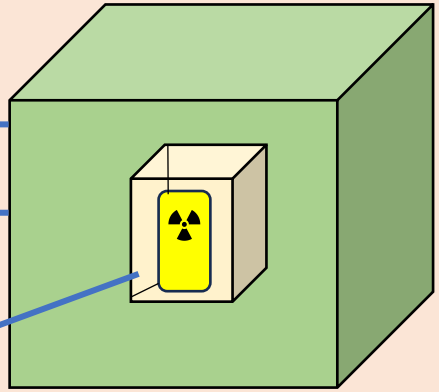
Surface wipe test: Did any external contamination occur at the shipping facility?

Surface and 1 meter dose rate: What type of package will this be:
Excepted / White I / Yellow II or Yellow III ?

If sealed source: Leak tested within the past 6 months?

Transit

Package received and checked-in



Surface wipe test: Did any external or internal contamination (from a ruptured or leaking source) occur during transit?

Surface and 1 meter dose rate: Did the contents shift during transit? Was the package type properly chosen by the shipper?

Inner package wipe test (patient dose) : Did the source leak during transit?

Why are there repeat requirements for surveys and wipe tests at both ends of the shipping chain?
This schematic diagram explains the reasoning behind the requirements.

(a) Excepted Package

If the package contains limited quantity (Table-1, page 7), *and* the maximum external dose rate is **less than or equal to 0.5 mrem/h**, 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.

(a) The package must be marked **UN2910** (for limited quantity material), or **UN2911** (for limited quantity instruments or articles). The marking must be at least 0.5" high, and placed on a vertical surface of the package. Alternatively, a commercially available sticker such as '**Excepted Package Limited Quantity of Material UN2910**' may be used; FedEx prefers two such labels on opposite vertical sides. 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, per DOT regulations. *However, FedEx prefers that a security seal be used.* 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 on page 8).

(d) Ensure that removable contamination on the carton exterior is less than 2,200 dpm/100 cm^2 for beta, gamma and low toxicity alpha emitters (or 220 dpm/100 cm^2 for other alpha emitters). This wipe test is a requirement for excepted packages, AND as a part of filling out the 'sealed source receipt and transfer record'. You only need to write down the wipe test result in the 'Sealed Source Receipt and Transfer Record'; you need not report the numbers on any DOT paperwork.

(e) Emergency response information is not required for excepted packages, per DOT regulations. However, if instructed (and provided) by the manufacturer, use it. *FedEx prefers emergency response information for UN2910 packages.* Affix a small FedEx pouch on the top of the carton and Insert the following:

> **(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 (more details on page 27).

IMPORTANT: 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. Typically, a nuclear medicine technologist's cellphone number can be used as emergency contact. Make sure you carry the cellphone with you at all times until you receive confirmation that the package has been delivered. *Chemtrec* is an organization that provides a 24 hour responder program and a toll-free contact number, if you set up an account with them. Details are at https://www.chemtrec.com/

(ii) A completed packing list or source return form, specifying the activity of the source at shipment, name of manufacturer, source serial and model numbers, activity and reference date shown on the source, date of satisfactory leak test, name telephone and signature of the package preparer, and date.

Place a copy of the completed packing list inside the package as well.

The two items above are provided in the vendor's return kit; specifics of the packing list vary with manufacturer.

(f) Affix a large FedEx plastic waybill pouch on the top of the carton. Insert the completed original 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.

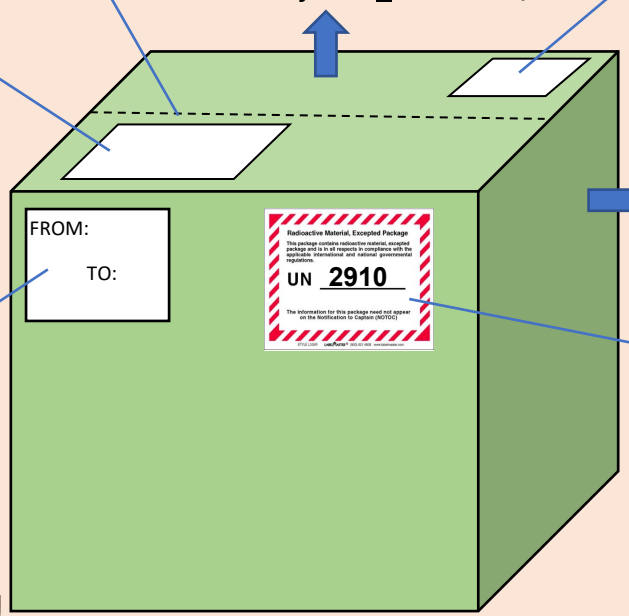
After the package has been successfully returned, obtain an acknowledgement of receipt of the source from the consignee and save in your files.

Security Seal

Large FedEx pouch containing:
(a) Completed Airbill

Measure and ensure: Dose rate at all 6 surfaces ≤ 0.5 mrem/h

Small FedEx pouch containing:
(a) Emergency Response Information, including 24 hour emergency contact number
(b) Return Packing List



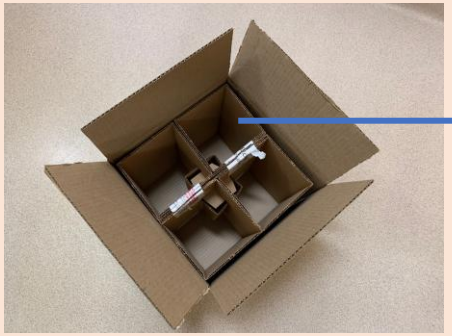
Maintain for your records: package exterior wipe test results showing < 2200 dpm/100 cm² (for beta / gamma emitters)

FROM and TO address, along with Return Authorization number (if applicable)

Red & white candy striped UN marking sticker (FedEx preference); affix 2 stickers, on opposite vertical sides of the box

The DOT requirement is only a UN Number Marking, at least 0.5 inch high.
However, FedEx may not accept this, and prefers that you use the candy-striped version of the label.
One marking is sufficient per package.

UN2910



Pack the source in the approved carton using the same spacers / braces as in the incoming shipment.

Inside the package:
(a) The word 'Radioactive' on the source or lead container or tin can holding the lead container. This is the recommended method.
Otherwise, the word 'Radioactive' has to be written on the surface of the package.
(b) One copy of Return Packing List

Schematic diagram of Excepted Package containing a sealed source shipped via FedEx

(b) Radioactive Material Package

Irrespective of whether the package contains limited quantity of radioactive material or not, if the maximum external dose rate on the surface of the package is **greater than 0.5 mrem/h**, 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"

(ii) The DOT shipping name, such as "Radioactive Material Type A package UN2915". This is the most common shipping name for materials typically shipped form nuclear medicine programs. (shipping names ending with **'n.o.s'** can no longer be used). Stickers with appropriate wordings are included in the return kit, and only one, on a vertical side of the package is required.

(iii) Name and address of the shipper and receiver. These are in addition to the address provided in the FedEx waybill. 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.

(b) Labeling requirements:

(i) Affix the appropriate 'Radioactive Material' diamond shaped label, based on the external dose rates listed in the Table-2 (page 10). **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 (µCi, mCi, Ci) may be added optionally in parenthesis following the SI units. Enter the Transport Index on 'Yellow II' and 'Yellow III' labels. Remember, there are no units (mrem/h, etc.) on TI values.

Useful conversions: 1 µCi = 37 kBq; 1 mCi = 37 MBq = 0.037 GBq = 0.000037 TBq; 1 Ci = 37 GBq

To convert		To convert	
	µCi to kBq: multiply by 37		kBq to µCi : multiply by 0.027
	µCi to MBq: multiply by 0.037		mBq to µCi: multiply by 27
	mCi to kBq: multiply by 37000		kBq to mCi: multiply by 0.000027
	mCi to MBq: multiply by 37		MBq to mCi: multiply by 0.027
	mCi to GBq: multiply by 0.037		GBq to mCi: multiply by 27
	mCi to TBq: multiply by 0.000037		TBq to mCi: multiply by 27027

(ii) Return kits for Yellow II and yellow III packages will also contain orange "**Cargo Aircraft Only**" labels. Affix two labels on opposite vertical sides of the carton, adjacent to the 'Radioactive' labels. 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.

IMPORTANT: Shipping name marking, 'Cargo Aircraft Only' label and 'Radioactive' label should be placed close to each other, but must not touch each other. Make sure that all required markings and labels on the carton 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.

(c) A **security seal** is required on the package (if not provided in the return kit, prepare your own seal: a sticker with the words 'Security Seal', or 'security seal – Notify Shipper if Broken', and tape it across the seam of the carton, covered with clear tape).

(d) Affix a small FedEx pouch on the top of the carton. Insert the following:

(i) Emergency Response Information applicable to a UN2915 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 number. If this information has not been provided by the vendor in the return kit, it can be printed from the *Emergency Response Guide 2019*, a PDF document obtainable by googling "ERG 2019". Guide 162 (PDF document pages 262-263) is appropriate for sealed source shipments. See more details on page 27.

(ii) A completed packing list (if required by the consignee) specifying the activity of the source at shipment, name of manufacturer, source serial and model numbers, activity and reference date shown on the source, date of satisfactory leak test, name, telephone and signature of the package preparer, and date.

(e) Affix a large FedEx plastic waybill pouch on the top of the carton. Insert the following:

(i) Three copies of completed 'shipper's declaration for dangerous goods' (also called 'shipping paper'). See details on page 8-9. 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:
https://www.fedex.com/content/dam/fedex/us-united-states/services/ShippersDecColumnsColorPrinter.pdf

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.

IMPORTANT: 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. Typically, a nuclear medicine technologist's cellphone number can be used as emergency contact. Make sure you carry the cellphone with you at all times until you receive confirmation that the package has been delivered. *Chemtrec* is an organization that provides a 24 hour responder program and a toll-free contact number, if you set up an account with them. Details are at https://www.chemtrec.com/

(ii) Completed original 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). UPS does not accept Radioactive Material packages.

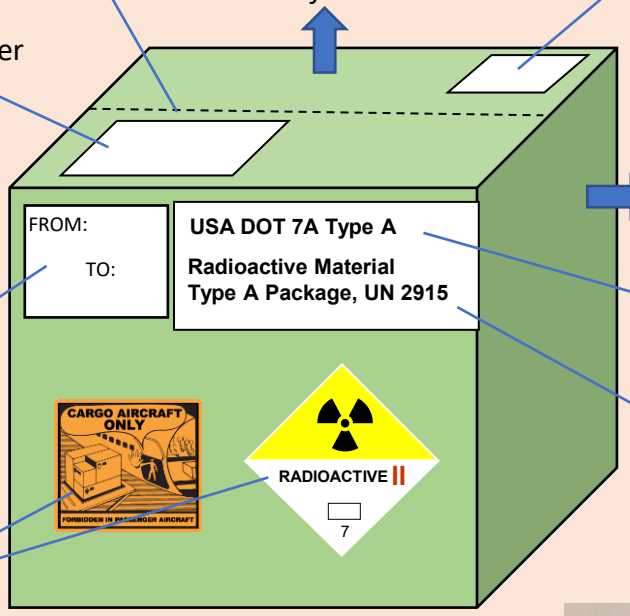
After the package has been successfully returned, obtain an acknowledgement of receipt of the source from the consignee and save in your files.

Security Seal

Measure and record maximum dose rates at surfaces and at 1 meter out of all 6 sides

Small FedEx pouch containing:
(a) Emergency Response Information, including 24 hour emergency contact number
(b) Return Packing List

Large FedEx pouch containing:
(a) Completed Airbill
(b) Three copies of Shipping Paper



Maintain for your records: package exterior wipe test results showing < 2200 dpm/100 cm^2 (for beta / gamma emitters)

Package Type Marking

DOT Shipping Name Marking

FROM and TO address, along with Return Authorization number (if applicable)

Inside the package:
(a) One copy of Return Packing List

'Cargo Aircraft Only' and 'Radioactive' labels, adjacent to, but not touching each other. Affix another set of labels on the opposite side

Pack the source in the approved carton using the same spacers / braces as in the incoming shipment.

Schematic diagram of Radioactive Yellow II package containing a sealed source shipped via FedEx

Part 2: *Spent Patient Dose Returns for Pickup by Vendor's Courier (Ground Transportation)*

(a) Prepare the package by placing spent syringes in the syringe pigs, and the syringe pigs within the foam braces as in the incoming package.

(b) Measure the dose rate on all six surfaces using a GM survey meter. For doses that have sufficiently decayed, dose rates generally are below 0.5 mrem/h, and the package can be sent as an Excepted Package. If the maximum dose rate exceeds 0.5 mrem/h, hold the package for decay until the next day ore more (depending on the radioisotopes present), and re-measure.

To ship the package as and Excepted Package, the total activity in the package at the time of pickup must not exceed the Limited Quantity (LQ) value of the radioisotope present. If shipping more than one isotope, the total activity must not exceed the most stringent LQ value of those isotopes. For example, if liquid ^{131}I and ^{201}Tl are shipped together, the total activity in the package must not exceed 1.9 mCi, because ^{131}I has the lower LQ value (Table 1, page 7). If the activity exceeds 8.1 mCi, and the external dose rate is less than 0.5 mrem/h, the package must be shipped as a White I package, as long as Type A quantity limits are not exceeded.

(c) Very likely, the incoming packages have a White-I label because dose rates are below 0.5 mrem/h, but the quantities in the doses exceed Limited Quantity levels. Flip the White-I laminated card so that the UN2910 marking shows on the outside of the package.

(d) Wipe the outside of the syringes and the outside of the fabric packaging. Ensure that the external wipe test does not exceed 2,200 dpm/100 cm^2. For larger areas wiped, the allowable removable contamination can be scaled accordingly, *e.g.*, 6,600 dpm/300 cm^2.

(e) Enter the required outgoing package information in NMIS, Nuctrak or other unit dose manager program.

(f) Leave the package in the designated area / lock box for pickup. Do not leave it in the corridor, mail room or any other unattended area.

Pack the source in the approved container using the same spacers / braces as in the incoming shipment.

Patient dose delivery packages used by GE Healthcae / RLS (top), Triad / Jubilant (middle) and Cardinal Health (bottom)

Further Requirements for Ground Transportation

If you want to transport radioactive materials by yourselves, instead of shipping them via FedEx or other qualified carriers, you need the appropriate radioactive materials license. The vast majority of medical licenses DO NOT allow such transport. Mobile Licenses permit you to carry patient doses and flood sources to satellite locations. Transporting radioactive materials without proper license authorization is a violation of your license conditions.

While the transporters do not need to carry calibration and leak test information (these need to be in your files), they do need to carry the appropriate shipping papers and emergency response information. A Bill of Lading (see examples next page) is an acceptable type of shipping paper for ground transportation. The shipping papers and emergency response forms 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), the maximum allowed package dose rate is 200 mrem/h (surface) and 10 mrem/h (at 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 mrem/h, and 1-meter dose rates exceeding 10 mrem/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 mrem/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 mrem/h; dose rate at 2.2 meters does not exceed 10 mrem/h; dose rate in a normally-occupied space (*e.*g., the diver's cab) does not exceed 2 mrem/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.

EXAMPLES of BILL OF LADING

Your Company's Letterhead .

BILL OF LADING

SHIPPER: ABC Biotechnology, Inc.
1 Madame Curie Dr.
Anytown, MA 01234

TO: Special Project Labs
200 Fermi Pl.
Somewhere, MA 04321

DATE: 1/1/2020

No. of Packages	Basic Description	Label	Transport Index	Form	Radionuclide	Activity
2	Radioactive Material, Type A package, 7, UN2915	Yellow -II	0.5	Solid (inorganic Salt)	P-32	370 MBq (10 mCi)
1	Radioactive Material, N.O.S., 7, UN2982	Yellow -III	1.3	Liquid	Tc-99m	1480 MBq (40 mCi)
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

Signature: _____ Date: _____

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

BILL OF LADING

SHIPPER: Healthy Hospital
1234 East West Street
Anytown, MA 01234

TO: Acme Radiopharmaceuticals
4321 West East Street
Anywhere, MA 04321

DATE: 1/1/2020

Radioactive Material, Type A Package, 7, UN2915

Radionuclide: ^{99}Mo
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

Signature: _____ Date: _____ .

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

Emergency Response Information

Eckert and Ziegler provides a standard emergency response form suitable for both UN2910 and UN2915 packages. This form can be downloaded at:
https://www.ezag.com/fileadmin/ezag/user-uploads/pdf/isotope/Sheet_B_-_final_01.pdf

Eckert & Ziegler
Isotope Products

EMERGENCY RESPONSE INFORMATION

(49 CFR 172.403, 172.600, 602, 604, 173.421)

Returns are only accepted at *1800 North Keystone Street, Burbank, California, 91504* in accordance with Eckert & Ziegler Isotope Products' Radioactive Materials License No. 1509-19. All information must be provided to ensure proper handling of your return.

Complete items 1 and 2:

1. √ SELECT ONE PROPER SHIPPING & HAZARD CLASS BELOW:
☐ A) UN2910, Class 7, Radioactive Material, Excepted Package, Limited Quantity of Material
☐ B) UN2911, Class 7, Radioactive Material, Excepted Package, Instruments or Articles
☐ C) UN2915, Class 7, Radioactive Material, Type A Package, Non-special Form, Non-fissile, or Fissile Excepted
☐ D) UN3332, Class 7, Radioactive Material, Type A Package, Special Form, Non-fissile, or Fissile Excepted
☐ E) Other: UN_____,
2. WRITE SHIPPER'S 24 HOUR EMERGENCY RESPONSE TELEPHONE No.: _____ This is your 24 hour telephone number should an emergency arise with your package during transit.
3. IMMEDIATE HAZARDS TO HEALTH: No significant hazards.
4. RISKS OF FIRE OR EXPLOSION: None
5. IMMEDIATE PRECAUTIONS: Keep non-essential people away from area; notify radiation safety authorities.
6. EMERGENCY FIRE MEASURES: Self-contained breathing apparatus and firefighters' protective gear should be used.
7. FIRST AID: Use standard first aid measures as required. Advise medical personnel that victim may be contaminated.

For sealed source shipments where emergency response information is not available, generic forms in the Emergency Response Guidebook (ERG) published by US DOT Pipeline and Hazardous Materials Safety Administration (PHMSA) can be used. These are available online and renewed periodically. The following are excerpts from the latest available (2016) version, available by googling 'ERG 2016'.

Guide # 161 is suitable for UN2910 packages

GUIDE 161 RADIOACTIVE MATERIALS (LOW LEVEL RADIATION)

POTENTIAL HAZARDS

HEALTH

- 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.
- Very low levels of contained radioactive materials and low radiation levels outside packages result in low risks to people. Damaged packages may release measurable amounts of radioactive material, but the resulting risks are expected to be low.
- Some radioactive materials cannot be detected by commonly available instruments.
- Packages do not have RADIOACTIVE I, II, or III labels. Some may have EMPTY labels or may have the word "Radioactive" in the package marking.

FIRE OR EXPLOSION

- Some of these materials may burn, but most do not ignite readily.
- Many have cardboard outer packaging; content (physically large or small) can be of many different physical forms.
- Radioactivity does not change flammability or other properties of materials.

PUBLIC SAFETY

- **CALL EMERGENCY RESPONSE Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.**
- **Priorities for rescue, life-saving, first aid, fire control and other hazards are higher than the priority for measuring radiation levels.**
- Radiation Authority must be notified of accident conditions. Radiation Authority is usually responsible for decisions about radiological consequences and closure of emergencies.
- As an immediate precautionary measure, isolate spill or leak area for at least 25 meters (75 feet) in all directions.
- Stay upwind, uphill and/or upstream.
- 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

- Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide adequate protection.

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.

EMERGENCY RESPONSE

FIRE

- Presence of radioactive material will not influence the fire control processes and should not influence selection of techniques.
- Move containers from fire area if you can do it without risk.
- Do not move damaged packages; move undamaged packages out of fire zone.

Small Fire

- Dry chemical, CO_2, water spray or regular foam.

Large Fire

- Water spray, fog (flooding amounts).

SPILL OR LEAK

- Do not touch damaged packages or spilled material.
- Cover liquid spill with sand, earth or other non-combustible absorbent material.
- Cover powder spill with plastic sheet or tarp to minimize spreading.

FIRST AID

- Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination.
- Call 911 or emergency medical service.
- Medical problems take priority over radiological concerns.
- Use first aid treatment according to the nature of the injury.
- Do not delay care and transport of a seriously injured person.
- Give artificial respiration if victim is not breathing.
- Administer oxygen if breathing is difficult.
- 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.

Guide # 162 is suitable for UN2915 packages

GUIDE 162 RADIOACTIVE MATERIALS (LOW TO MODERATE LEVEL RADIATION)

POTENTIAL HAZARDS

HEALTH

- 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.
- 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.
- Low radiation hazard when material is inside container. If material is released from package or bulk container, hazard will vary from low to moderate. Level of hazard will depend on the type and amount of radioactivity, the kind of material it is in, and/or the surfaces it is on.
- Some material may be released from packages during accidents of moderate severity but risks to people are not great.
- Released radioactive materials or contaminated objects usually will be visible if packaging fails.
- Some exclusive use shipments of bulk and packaged materials will not have "RADIOACTIVE" labels. Placards, markings and shipping papers provide identification.
- Some packages may have a "RADIOACTIVE" label and a second hazard label. The second hazard is usually greater than the radiation hazard; so follow this GUIDE as well as the response GUIDE for the second hazard class label.
- Some radioactive materials cannot be detected by commonly available instruments.
- Runoff from control of cargo fire may cause low-level pollution.

FIRE OR EXPLOSION

- Some of these materials may burn, but most do not ignite readily.
- Uranium and Thorium metal cuttings may ignite spontaneously if exposed to air (see GUIDE 136).
- Nitrates are oxidizers and may ignite other combustibles (see GUIDE 141).

PUBLIC SAFETY

- **CALL EMERGENCY RESPONSE Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.**
- **Priorities for rescue, life-saving, first aid, fire control and other hazards are higher than the priority for measuring radiation levels.**
- Radiation Authority must be notified of accident conditions. Radiation Authority is usually responsible for decisions about radiological consequences and closure of emergencies.
- As an immediate precautionary measure, isolate spill or leak area for at least 25 meters (75 feet) in all directions.
- Stay upwind, uphill and/or upstream.
- 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

- Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide adequate protection.

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.

In Canada, an Emergency Response Assistance Plan (ERAP) may be required for this product. Please consult the shipping document and/or the ERAP Program Section (page 391).

EMERGENCY RESPONSE

FIRE

- Presence of radioactive material will not influence the fire control processes and should not influence selection of techniques.
- Move containers from fire area if you can do it without risk.
- Do not move damaged packages; move undamaged packages out of fire zone.

Small Fire

- Dry chemical, CO_2, water spray or regular foam.

Large Fire

- Water spray, fog (flooding amounts).
- Dike fire-control water for later disposal.

SPILL OR LEAK

- Do not touch damaged packages or spilled material.
- Cover liquid spill with sand, earth or other non-combustible absorbent material.
- Dike to collect large liquid spills.
- Cover powder spill with plastic sheet or tarp to minimize spreading.

FIRST AID

- Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves.
- Call 911 or emergency medical service.
- Medical problems take priority over radiological concerns.
- Use first aid treatment according to the nature of the injury.
- Do not delay care and transport of a seriously injured person.
- Give artificial respiration if victim is not breathing.
- Administer oxygen if breathing is difficult.
- In case of contact with substance, wipe from skin 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.

Section 4: Security Awareness Training

Security awareness pertaining to radioactive material shipments from a nuclear medicine program: Dose rates from sealed sources used in nuclear medicine departments represent minimal human health risk because of the low activities contained in them. Similarly, unsealed spent patient doses sources are low-risk because of the relatively short half lives of isotopes used in diagnostic nuclear medicine.

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 patient doses and calibration sources in the hot lab:

1. All material must be secured unless under the direct and constant supervision of an authorized individual.
2. Hand over shipping packages only to authorized FedEx (or other shipping company) representatives / workers.
3. Do not leave an outgoing package in a mail room at the facility or at any location unattended; have the FedEx driver pick it up in person from the nuclear medicine department.
4. Do not drive the package to a FedEx location or third party pickup location to drop it off.
5. Unless there are provisions for a secure delivery location / delivery box, do not have incoming packages delivered to the mail room or to any other department / individual other than nuclear medicine.
6. 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.

- END OF DOCUMENT -