

HAZMAT DOT Training

Transportation of Radioactive Materials



presented by

RADIOL**GY**
TRAINING ASSOCIATES
Anywhere. Anytime. It's that simple.

Outline

- ◉ Hazardous Material & Hazard Classifications
- ◉ Regulations
- ◉ Training Requirements
- ◉ Radioactive Materials Classifications
- ◉ Survey & Contamination Limits
- ◉ Package Receipt & Shipment
- ◉ Shipping Papers
- ◉ Safety & Security

Hazardous Material

- A hazardous material is any item or chemical, which, when being transported or moved in commerce, is a risk to public safety or the environment



Hazard Classifications

- ◉ Class 1 – Explosives
- ◉ Class 2 – Gases
- ◉ Class 3 – Flammable Liquids
- ◉ Class 4 – Flammable Solids
- ◉ Class 5 – Oxidizing Substances
- ◉ Class 6 – Toxic and Infectious Substances
- ◉ Class 7 – Radioactive Material

Regulations

- ◉ Title 49, Code of Federal Regulations
- ◉ Subchapter C – Hazardous Materials Regulations
 - 171 – General Information, Regulations, and Definitions
 - 172 – Hazardous Materials Table, Emergency Response Information, Training Requirements
 - 173 – General Requirements
 - 175 – Carriage by Aircraft
 - 177 – Carriage by Public Highway
 - 178 – Specifications for Packagings

Training

- ◉ Training must be certified by employer
- ◉ Required 90 days after employment and every 3 years
- ◉ Required Topics
 - General Awareness/Familiarization Training
 - Function-Specific Training
 - Safety Training
 - Security Awareness Training



Classification

Form

- Special Form – solid metal or high integrity encapsulation
- Normal form – everything else
- A_1 & A_2 values

Quantity

- Limited Quantity
- Type A Quantity

UN Numbers

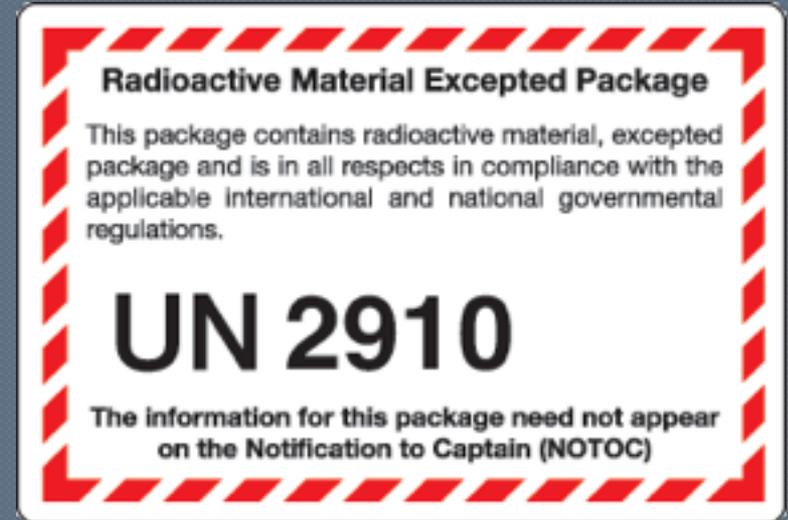
- UN 2910
- UN 2915

Table A-1— A_1 and A_2 VALUES FOR RADIONUCLIDES

Symbol of radionuclide	Element and atomic number	A_1 (TBq)	$A_1(\text{Ci})^b$	A_2 (TBq)	$A_2(\text{Ci})^b$	Specific activity	
						(TBq/g)	(Ci/g)
Ac-225 (a)	Actinium (89)	8.0×10^{-1}	2.2×10^2	6.0×10^{-3}	1.6×10^{-1}	2.1×10^1	5.8×10^4
Ac-227 (a)		9.0×10^{-1}	2.4×10^2	9.0×10^{-2}	2.4×10^{-1}	2.7	7.2×10^1
Ac-228		6.0×10^{-1}	1.6×10^2	5.0×10^{-1}	1.4×10^1	8.4×10^4	2.2×10^6
Ag-105	Silver (47)	2.0	5.4×10^2	2.0	5.4×10^1	1.1×10^1	3.0×10^4
Ag-108m (a)		7.0×10^{-1}	1.9×10^2	7.0×10^{-1}	1.9×10^1	9.7×10^{-1}	2.6×10^1
Ag-110m (a)		4.0×10^{-1}	1.1×10^2	4.0×10^{-1}	1.1×10^1	1.8×10^1	4.7×10^1
Ag-111		2.0	5.4×10^2	6.0×10^{-1}	1.6×10^1	5.8×10^1	1.6×10^5
Al-26	Aluminum (13)	1.0×10^{-1}	2.7	1.0×10^{-1}	2.7	7.0×10^{-4}	1.9×10^{-7}
Am-241	Americium (95)	1.0×10^1	2.7×10^2	1.0×10^{-2}	2.7×10^{-1}	1.3×10^{-1}	3.4
Am-242m (a)		1.0×10^1	2.7×10^2	1.0×10^{-2}	2.7×10^{-1}	3.6×10^{-1}	1.0×10^1
Am-243 (a)		5.0	1.4×10^2	1.0×10^{-2}	2.7×10^{-1}	7.4×10^{-1}	2.0×10^{-1}
Ar-37	Argon (18)	4.0×10^1	1.1×10^2	4.0×10^1	1.1×10^2	3.7×10^1	9.9×10^4
Ar-39		4.0×10^1	1.1×10^2	2.0×10^1	5.4×10^1	1.3	3.4×10^1
Ar-41		3.0×10^{-1}	8.1	3.0×10^{-1}	8.1	1.5×10^6	4.2×10^7
As-72	Arsenic (33)	3.0×10^{-1}	8.1	3.0×10^{-1}	8.1	6.2×10^4	1.7×10^6

UN 2910, Limited Quantity

- Excepted Package
- Surface Exposure Rate
 - < 0.5 mrem/hr
 - No TI
- Contamination Limit
 - < 2400 dpm / 100 cm²
- Activity must be less than $10^{-4} A_2$ value
 - ^{99m}Tc – 11 mCi
 - ¹⁸F – 1.6 mCi
 - 49 CFR 173.435



Efficiency

- dpm – disintegrations per minute
- cpm – counts per minute
- Typical efficiencies
 - Co57 – 70% - 80%
 - Cs137 – 8% - 12%

$$\text{Efficiency} = \frac{\text{cpm}}{\text{dpm}}$$

$$\text{dpm} = \frac{\text{cpm}}{\text{efficiency}}$$

UN 2915, Type A Package

◉ Radioactive Package

- White I
- Yellow II
- Yellow III

◉ Contamination Limit

- $< 2400 \text{ dpm} / 100 \text{ cm}^2$

◉ Transportation Index

- mrem/hr at 1 meter

◉ Activity can be up to the A_2 value

- ^{99m}Tc – 110 Ci
- ^{18}F – 16 Ci



Survey & Contamination Limits



	Contamination Limits
Alpha	24 dpm/cm²
Beta / Gamma	240 dpm/cm²



Label	Surface (mrem/hr)	TI (mrem/hr)
Excepted Package	≤ 0.5	None
White I	≤ 0.5	None
Yellow II	≤ 50	≤ 1.0
Yellow III	≥ 50	≥ 1.0



Receipt Process

- ◉ Receipt within 3 hours
- ◉ Visually inspect for damage
- ◉ Monitor package radiation levels and radioactive contamination
 - GM Meter
 - Well Counter
 - 300 cm²
- ◉ Make sure content agree with packing slip
- ◉ Wipe inside if you suspect contamination
- ◉ Call RSO if contaminated, leaking, damaged, or missing contents

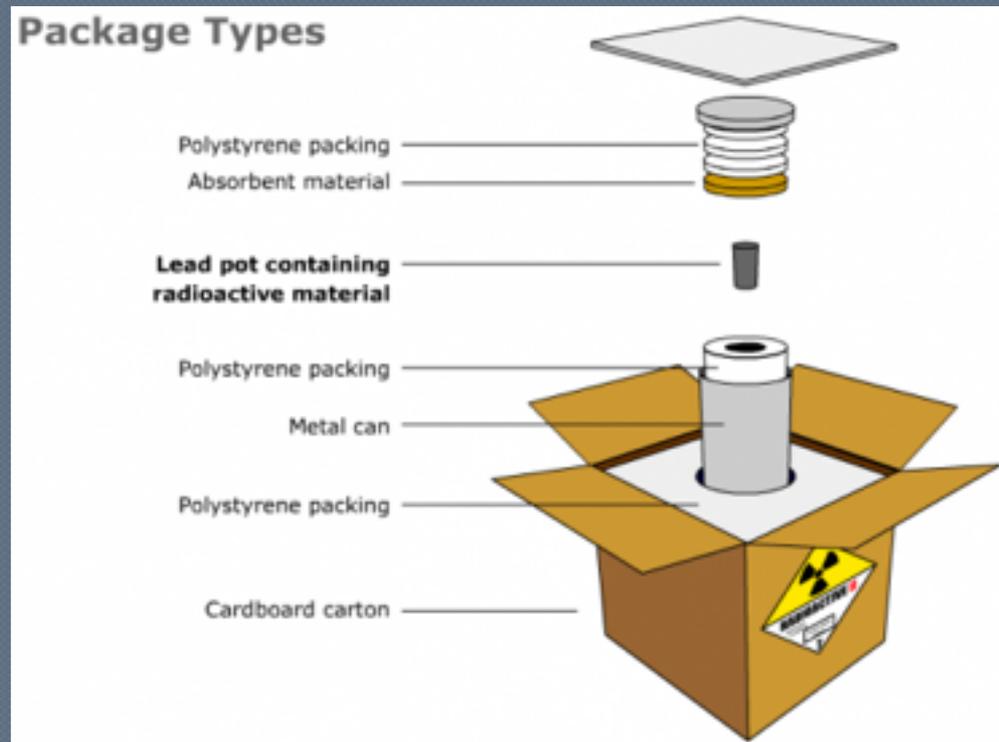
Shipping Process Overview

- Package Materials
- Survey the Package
- Label the Package
- Mark the Package
- Complete Shipping Papers, if required



Package Materials

- Packaging should be designed to securely hold radioactive contents



Package Survey



	Contamination Limits
Alpha	24 dpm/cm²
Beta / Gamma	240 dpm/cm²

Label	Surface (mrem/hr)	TI (mrem/hr)
Excepted Package	≤ 0.5	None
White I	≤ 0.5	None
Yellow II	≤ 50	≤ 1.0
Yellow III	≥ 50	≥ 1.0

Mark & Label the Package

- ◉ Labels

- Standard hazmat identifiers placed on packages
- Must be placed on opposite sides of package

- ◉ Markings

- Additional identifiers that further describe the package
- “USA DOT 7A Type A”

- ◉ Security Seal



Mark & Label the Package

- **Cargo Aircraft Only**

- Labels on opposite side of package
- Unless material is intended for use in research, medical diagnosis, or treatment
- Most air carriers have adopted their own regulations through International Air Transportation Association (IATA)
- Any package with a TI < 3.0 can go aboard a passenger aircraft (cumulative TI < 50)



Shipping Papers

◉ Includes

- Consignee (To) & Consignor (From)
- Proper Shipping Name & Hazard Class
- Package Description
- Transportation Index
- Number of Packages
- Activity in SI Units (MBq)
- Emergency Response Telephone Number

SHIPPER'S DECLARATION FOR DANGEROUS GOODS

(Provide at least three copies to the airline.)

Shipper	Air Waybill No.
	Page of Pages
	Shipper's Reference Number

Consignee	
-----------	--

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

WARNING

Failure to comply with all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties.

TRANSPORT DETAILS

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

Airport of Departure

PASSENGER AND CARGO AIRCRAFT	CARGO AIRCRAFT ONLY
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Airport of Destination:

Shipment type: (delete non-applicable)

NON-RADIOACTIVE	RADIOACTIVE
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NATURE AND QUANTITY OF DANGEROUS GOODS

Dangerous Goods Identification

UN or ID No.	Proper Shipping Name	Class or Division (Subsidiary Risk)	Packing Group	Quantity and type of packaging	Packing Inst.	Authorization

Additional Handling Information

--

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 of the applicable air transport requirements have been met.

Name/Title of Signatory

Place and Date

Signature (see warning above)

Emergency Telephone Number

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. ADR EUROPEAN TRANSPORT STATEMENT: CARRIAGE IN ACCORDANCE WITH 1.1.A.2.1

FedEx Express Package
US Airbill

Tracking Number: 1234 5678 901C

1 From Please print and press hard

Date: 3/1/15

Sender's FedEx Account Number: 9999-9999-9

Sender's Name: Tyler Hanson Phone: 662-555-1812

Company:

Address: 1234 Main Street

City: Phoenix State: AZ ZIP: 85034

2 Your Internal Billing Reference

OPTIONAL

3 To

Recipient's Name: Liam Riley Phone: 405-555-8300

Company: Ridgeway Design

Address: 2020 Vision Street

We cannot deliver to PO boxes or P.O. ZIP codes.

Day/Evening/Week

Address:

City: Atlanta State: GA ZIP: 30305

Hold Weekday
FedEx for other address
REQUIRED **NOT** available for
FedEx First Overnight

Hold Saturday
FedEx for other address
REQUIRED **NOT** available for
FedEx Priority Overnight and
FedEx 2Day services

City: Atlanta State: GA ZIP: 30305



Ship it. Track it. Pay for it. All online.
Go to fedex.com

ZIP: 0200

Sender's Copy

4 Express Package Service

* Select one service

Packages up to 150 lbs.

For packages over 150 lbs., use the
FedEx Express Freight® Airbill

Next Business Day

FedEx First Overnight

Get next business morning delivery to select
locations. Delivery times will be delayed on
Monday unless Saturday Delivery is selected.

FedEx Priority Overnight

Next business morning. Delivery times will be
delayed on Monday unless Saturday Delivery
is selected.

FedEx Standard Overnight

Next business afternoon.
Saturday Delivery NOT available.

2 or 3 Business Days

FedEx 2Day AM

Two and overnight morning.
Saturday Delivery NOT available.

FedEx 2Day

Second business afternoon. Saturday packages
will be delivered on Monday unless Saturday
Delivery is selected.

FedEx Express Saver

Third business day.
Saturday Delivery NOT available.

5 Packaging

* Select one box type

FedEx Envelope*

FedEx Pak*

FedEx Box

FedEx Tube

Other

6 Special Handling and Delivery Signature Options

How may apply. See the FedEx Service Guide.

Saturday Delivery

Not available for FedEx Standard Overnight.

No Signature Required

Package may be left without
obtaining a signature for delivery.

Direct Signature

Signature of recipient's address
may apply for delivery.

Indirect Signature

It is not available at recipient's
address, signature of recipient's
address may apply for delivery for
recipient's business only.

Does this shipment contain dangerous goods?

No

Yes
As per original
Shipper's Declaration.

Yes
Shipper's Declaration
not required.

Dry Ice
Dry Ice, 6, 10, 100

Restrictions apply for dangerous goods — see the current FedEx Service Guide.

Cargo Aircraft Only

7 Payment All for

Enter FedEx Account No. or Credit Card No. below

Sender

And You Select
FedEx Billing

Recipient

Third Party

Credit Card

Cash/Check

FedEx Account No.

or

Credit Card No.

Total Packages: 1

Total Weight: 1

Total Declared Value: 450

Your liability is limited to \$1000 unless you declare a higher value. See back for details. Reviewing this airbill and your
signature to the service conditions on the back of this airbill and in the current FedEx Service Guide, including terms
that limit our liability.

Rev. 1/09 174-Pak/FPMR-0202-01-15 FedEx-PRINTED IN U.S.A. 010000

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fedex.com 1800.GoFedEx 1800.463.3339

ROLL AND RETURN THIS COPY BEING AFFIXED TO THE PACKAGE. NO OTHER AIRBILLS.

Returning Used Radiopharmaceuticals

- ◉ When returning used or spent radiopharmaceutical pigs as UN 2910, you still must
 - Wipe the package
 - $< 2400 \text{ dpm} / 100 \text{ cm}^2$
 - Survey package
 - $\leq 0.5 \text{ mrem/hr}$
 - Mark and label package
 - “UN 2910, Radioactive Material, Excepted Package, Limited Quantity”

Safety & Security

- Always wear gloves when handling radioactive packages
- Visually inspect package for physical damage
- Packages should be delivered directly to nuclear medicine
- Packages should be secured from unauthorized removal
 - Always lock the hot lab door

Contact Information

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