

RI-14

RI-14 SHIPMENT OF RADIOACTIVE MATERIAL

PURPOSE

This procedure contains instructions and check lists to assure compliance with federal regulations for local transfer or commercial shipment of radioactive material.

RULES AND REGULATIONS

Radioactive materials may be transferred or shipped to another licensee only after verification that all licensing, transfer, packaging, labeling and transportation requirements have been met. To assure that all requirements are met, and that appropriate records are maintained, a checklist must be prepared by the individual responsible for the shipment and approved by the RCO before the shipment is made.

In the event of a transportation accident immediately contact the Radiation Control Office. Upon the notification of an accident involving radioactive materials, the Radiation Control Office will inform the Colorado Department of Public Health and Environment.

PROCEDURES

1. The person planning to transfer radioactive material to any individual or institution that is not under the University's license must first ascertain whether the material is a "limited quantity", "Surface Contaminated Object" (SCO)
2. Before packaging or labeling the material, complete the appropriate checklist:
 - For limited quantity shipments to other licensees, use "RADIOISOTOPE LIMITED QUANTITY SHIPMENT" (RF-14A).
 - For limited quantity shipments within the University use, "RADIOISOTOPE LIMITED QUANTITY SHIPMENT" (RF-14B).
 - For shipment of waste material to CSU waste facilities use, "RADIOACTIVE SHIPMENT RECORD" (RF-14C).
 - For common carrier training use, "CARRIER TRAINING" (RF-14D).
 - For LSA or Type A quantities of radioactive material use, "COMMON CARRIER SHIPMENT OF RADWASTE" (RF-14E).

- For exclusive-use vehicle shipment use, "EXCLUSIVE-USE VEHICLE SHIPMENT OF LSA RADWASTE" (RF-14F).
 - For exclusive-use driver's instructions use, "EXCLUSIVE-USE VEHICLE SURVEY AND DRIVER'S INSTRUCTIONS" (RF-14G).
 - For common carrier shipment of type A material use, "COMMON CARRIER SHIPMENT OF TYPE A RADIOACTIVE MATERIAL" (RF-14H).
 - For density or moisture gauges use, "BILL OF LADING" (RF-14I).
 - For articles or instruments use, "SHIPMENT OF ARTICLES OR INSTRUMENTS CONTAINING OR CONTAMINATED WITH RADIOACTIVE MATERIALS" (RF-14J).
 - For type A packaging tests use, "TYPE A PACKAGING TESTS AND REQUIREMENTS" (RF-14K).
3. Prior to shipment, the RCO's designee must verify the license status and shipping address of the consignee, and approve the packaging and contamination survey.

AIRBORNE SHIPMENT

The only radioactive materials that may be transported on a passenger-carrying aircraft are those intended for use in, or incident to, research or medical diagnosis or treatment. Form RF-14L can be included with required shipping paperwork with most carriers.

DEFINITIONS - USDOT [References to 49 CFR]

Radioactive Material: Any material with a specific activity greater than 2 nCi g⁻¹ [173.403(y)].

Limited Quantity of Radioactive Material: A package that is exempt from specific packaging and labeling requirements because it contains no more than the following:

Solids (any form): 0.001 A₂
Liquids (except tritiated water): 0.0001 A₂

A₁ and A₂ values are provided in Table 1 below. Additional limits are provided in 173.423. Other limits apply if being shipped as an "Instrument or Article". See Table 7 below.

Contamination Control: The level of non-fixed (removable) contamination on the external surfaces of each package offered for shipment shall be kept as low as practicable. The level of non-fixed radioactive contamination may be determined by wiping and area of 300 cm² of the surface concerned with absorbent material, using moderate pressure, and measuring the activity on the wiping material. Sufficient measurements shall be taken in the most appropriate locations to yield a representative assessment of the non-fixed contamination levels. The amount of radioactivity measured on any single wiping material when averaged over the surface wiped shall not exceed the limits given in Table 11 (below) at any time during transport.

Example of contamination calculation would be as follows:

1. Obtain a background count rate with the survey probe away from any radioactive material.
2. Perform a wipe as described above on the radioactive material that is being offered for shipment.
3. Count the wipe material with the probe and record the gross count rate. Subtract the background count rate from the count rate on the wipe for the net count rate (Gross Count Rate - Background Count Rate = Net Count Rate).
4. On the side of the instrument a sticker is attached describing the beta response. Determine the correct isotope data from the sticker and calculate the efficiency of the detector by taking:

For Instruments Reading in Counts sec⁻¹

$$\frac{\text{Net Source Counts sec}^{-1} * 60}{\text{Source Activity in uCi} * 2.22 \text{ E } 6}$$

For Instruments Reading in Counts min⁻¹

$$\frac{\text{Net Source Counts min}^{-1}}{\text{Source Activity in uCi} * 2.22 \text{ E } 6}$$

5. Determine the Activity in dpm/cm² of the wipe by:

$$\frac{\text{Net Sample Counts}}{\text{Efficiency} * \text{Area Wiped in cm}^2}$$

6. The dpm cm⁻² value must be below the Table 11 value.
7. Although instruments may differ, the same basic calculations are performed. Contact the Radiation Control Office with any questions concerning this calculation.
8. Some instruments may have the efficiency on the calibration sticker located on the side of the survey instrument. Use the appropriate given efficiency if available.

LABELS

Appropriate Avery labels can be generated using the pages at the end of these instructions.

Table 1. DOT TYPE A QUANTITIES [173.435]

Nuclide	A ₁ (Ci)	A ₂ (Ci)	Nuclide	A ₁ (Ci)	A ₂ (Ci)
Am-241	54.1	0.005	Nb-95	27	27
Au-198	81.1	13.5	Ni-63	1080	811
Ba-133	81.1	81.1	Np-237	54.1	0.005
Bk-249	1080	2.16	P-32	8.11	8.11
C-14	1080	54.1	Pm-147	1080	24.3
Ca-45	1080	24.3	Po-209	1080	0.541
Cd-109	1080	27	Po-210	1080	0.541
Ce-139	162	162	Pu-238	54.1	0.005
Ce-141	270	13.5	Pu-239	54.1	0.005
Cf-249	54.1	0.005	Pu-241	1080	0.270
Cf-252	2.70	0.027	Pu-242	54.1	0.005
Cl-36	541	13.5	Ra-224	8.11	1.82
Cm-243	81.1	0.008	Ra-226	8.11	1.82
Cm-244	1080	0.011	Ra-228	16.2	1.08
Co-57	216	216	Rb-86	8.11	8.11
Co-60	10.8	10.8	Ru-103	54.1	24.3
Cr-51	811	811	Ru-106	5.41	5.41
Cs-134	16.2	13.5	S-35	1080	54.1
Cs-137	54.1	13.5	Sc-46	13.5	13.5
Fe-55	1080	1080	Se-75	81.1	81.1
Fe-59	21.6	21.6	Sn-113	108	108
Ga-67	162	162	Sr-85	54.1	54.1
Ga-68	8.11	8.11	Sr-90	5.41	2.70
Gd-153	270	135	Tc-99	1080	24.3
Ge-68	8.11	8.11	Tc-99m	216	216
H-3	1080	1080	Th-227	243	0.27
Hg-197	270	270	Th-228	8.11	0.011
Hg-203	108	24.3	Th-230	54.1	0.005
I-123	162	162	Th-232	Unlimited	Unlimited
I-125	541	54.1	Th-234	5.41	5.41
I-129	Unlimited	Unlimited	Th-Nat	Unlimited	Unlimited
I-131	81.1	13.5	Tl-201	270	270
In-111	54.1	54.1	Tl-204	108	13.5
In-113m	108	108	U- Nat	Unlimited	Unlimited
Ir-192	27	13.5	U-233	270	0.027
Kr-85	541	270	U-234	270	0.027
Mn-54	27	27	U-235	Unlimited	Unlimited
Mo-99	16.2	13.5	U-238	Unlimited	Unlimited
Na-22	13.5	13.5	Xe-133	541	541
Na-24	5.41	5.41	Zn-65	54.1	54.1

**Table 7 - Activity Limits for Limited Quantities,
Instruments, and Articles [173.423]**

Nature of Contents	Instrument and articles		Materials package limits
	Instrument and article limits ¹	Package limits	
Solids:			
Special form.....	$10^{-2}A_1$	A_1	$10^{-3}A_1$
Other forms.....	$10^{-2}A_2$	A_2	$10^{-3}A_2$
Liquids - Tritiated water:			
< 0.1 Ci/Liter.....	1,000 Ci
0.1 Ci to 1.0 Ci/Liter.....	100 Ci
>1.0 Ci/L.....	1 Ci
Other	10^{-}	10^{-}	$10^{-4}A_2$
Liquids.....	3A_2	1A_2	
Gases:			
Tritium ²	$2 \times 10^{-2}A_2$	$2 \times 10^{-1}A_2$	$2 \times 10^{-2}A_2$
Special form.....	$10^{-3}A_1$	$10^{-2}A_1$	$10^{-3}A_1$
Other forms.....	$10^{-3}A_2$	$10^{-2}A_2$	$10^{-3}A_2$

¹ For mixture of radionuclides see 173.433(b)

² These values also apply to tritium in activated luminous paint and tritium adsorbed on solid carriers.

**Table 11 - NON-FIXED EXTERNAL RADIOACTIVE
CONTAMINATION - WIPE LIMITS [173.443]**

Contaminant	Maximum permissible limits	
	$\mu\text{Ci cm}^{-2}$	dpm cm^{-2}
Beta and gamma emitters and low toxicity alpha emitters.....	10^{-5}	22
All other alpha emitting radionuclides.....	10^{-6}	2.2

RF-14A RADIOISOTOPE LIMITED QUANTITY SHIPMENT

This form is to be completed for shipment of a Limited Quantity of Radioactive Material to a non-University licensee. The individual desiring authorization to ship the material shall complete this form and submit it to the RCO's designee for approval before the material is shipped.

COLORADO STATE UNIVERSITY EMERGENCY RESPONSE TELEPHONE (970) 491-6425

Consignor (Colorado State University Principal User):

Name: _____ Phone: _____

Department: _____ Address: _____

Consignee (Individual and Organization):

Name: _____ Phone: _____

Address: _____

Authorization:

Consignee's License #: _____ Expiration Date: _____

Consignee's RSO: _____ Phone: _____

License copy on file? Yes or

Other verification: _____

Package Contents and Hazardous Material Classification:

<u>Initials</u>	<u>Contents</u>
_____	Radionuclide: _____ Activity: _____ mCi Inv# _____ DOT A ₂ Limit: _____ mCi
_____	Radionuclide: _____ Activity: _____ mCi Inv# _____ DOT A ₂ Limit: _____ mCi
_____	Radionuclide: _____ Activity: _____ mCi Inv# _____ DOT A ₂ Limit: _____ mCi

Sum of the Fractions (must be less than 1 if more than one radionuclide) _____

Initials **Limited Quantity Criteria**

- _____ Solid material and Sum of the Fractions less than 1. [173.423]
- _____ Liquid material and Sum of the Fractions less than 1. [173.423]
- _____ Less than 15 grams ²³⁵U. [173.421(e)]
- _____ The package contains no hazardous material other than radioactive material.

Container

- _____ Strong, tight package that will not leak during conditions normally incident to transportation [173.24 and 173.421(a)].

Labels and Markings

- _____ Names of consignee and consignor on outside of package.
- _____ The following statement must be on the package and on the shipping paper: **"This package conforms to the conditions and limitations specified in 49 CFR 173.421 for excepted radioactive material, limited quantity, n.o.s., UN2910."** Unless it is an instrument or article, see [173.421-l(a)]
- _____ If it is to be shipped on a passenger-carrying aircraft, the following certification is required on the shipping paper: **"The above-named materials are intended for use in, or incident to, research or medical diagnosis or treatment."** [172.204(c)]
- _____ The outside of the inner package or, if there is no inner packaging, the outside of the packaging itself bears the marking "Radioactive". [173.421 (d)]

Prepared by (signature): _____ Date: _____

Initials **Radiation Survey:**

- _____ Maximum at surface = _____ mR hr⁻¹
- _____ Less than 0.5 mR hr⁻¹ at all points on the surface of the container. [173.421]
- _____ Contamination: _____ dpm cm⁻²
- _____ Less than 2.2 dpm cm⁻² alpha and less than 22 dpm cm⁻² beta-gamma removable contamination.

Surveyed by (signature): _____ Date: _____

RSO approval (signature): _____ Date: _____

RF-14B RADIOISOTOPE LIMITED QUANTITY SHIPMENT

This form is to be completed for shipment of a **Limited Quantity of Radioactive Material across public by-ways to another Colorado State University facility**. The individual desiring authorization to ship the material shall complete this form and submit it to the RCO's designee for approval **prior to the material being shipped**.

Consignor (Colorado State University Principal User):

Name: _____ Phone: _____ Department: _____

Consignee (Colorado State University Shipper):

Name: _____ Phone: _____ Department: _____

Package Contents and Hazardous Material Classification:

<u>Initials</u>	<u>Contents</u>
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_____	Radionuclide: _____ Activity: _____ mCi Inv# _____ DOT A ₂ Limit: _____ mCi
_____	Radionuclide: _____ Activity: _____ mCi Inv# _____ DOT A ₂ Limit: _____ mCi
_____	Radionuclide: _____ Activity: _____ mCi Inv# _____ DOT A ₂ Limit: _____ mCi
_____	Radionuclide: _____ Activity: _____ mCi Inv# _____ DOT A ₂ Limit: _____ mCi

Sum of the Fractions (must be less than 1 if more than one radionuclide) _____

Limited Quantity Criteria

_____ Solid material and Sum of the Fractions less than 1. [173.423]
_____ Liquid material and Sum of the Fractions less than 1(Except Tritiated Water). [173.423]
_____ Less than 15 grams ²³⁵U. [173.421(e)]
_____ The package contains no hazardous material other than radioactive material.

<u>Initials</u>	<u>Container</u>
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_____	Strong, tight package that will not leak during conditions normally incident to transportation [173.24 and 173.421(a)].
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49 CFR-14B RADIOISOTOPE LIMITED QUANTITY SHIPMENT

Labels and Markings

- _____ Names of consignee and consignor on outside of package.
- _____ The following statement must be on the package and on the shipping paper:
"This package conforms to the conditions and limitations specified in 49 CFR 173.421 for excepted radioactive material, limited quantity, n.o.s., UN2910." Unless it is an instrument or article, see [173.421-1(a)]
- _____ If it is to be shipped on a passenger-carrying aircraft, the following certification is required on the shipping paper: **"The above-named materials are intended for use in, or incident to, research or medical diagnosis or treatment."** [172.204(c)]
- _____ The outside of the inner package or, if there is no inner packaging, the outside of the packaging itself bears the marking "Radioactive". [173.421 (d)]

Initials

Radiation Survey:

Maximum at surface = _____ mR hr⁻¹

_____ Less than 0.5 mR hr⁻¹ at all points on the surface of the container. [173.421]

Contamination: _____ dpm/cm²

_____ Less than 2.2 dpm cm⁻² alpha and less than 22 dpm cm⁻² beta-gamma removable contamination (in accordance with Table 11).

I certify that this package containing the material listed on this form meets all DOT regulations for shipping radioactive material.

Signature: _____ Date: _____

COLORADO STATE UNIVERSITY
EMERGENCY RESPONSE TELEPHONE (970) 491-6745



RF-14C RADIOACTIVE SHIPMENT RECORD

Colorado State University
 Environmental Health Services
 Fort Collins, CO 80523-6021
 (970) 491-6745 Fax 491-4804

Record No.

Date:

Emergency Phone Number
 CSU Radiation Control Office
(970) 491-4835

Page 1 of 1

Does this shipment contain RADIOACTIVE WASTE?	YES	Total Number of Packages Identified On This Record 1
Is a copy of form RF-54R or U "Common Carrier Shipment of Radioactive Waste" attached?	NO	From: Colorado State University Environmental Health Services Radiation Control Office Fort Collins, CO 80523-6021 Contact James C. Graham, RSO Radioactive Materials License No. Colorado 002-19
Is this an "EXCLUSIVE USE" Shipment?	NO	
Is a copy of form RF-54S "Exclusive Use Vehicle Shipment of Radioactive Waste" attached?	N/A	
Is a copy of form RF-54T "Exclusive Use Vehicle Survey and Driver's Instructions" attached?	N/A	
Does EPA regulated waste requiring a manifest accompany this shipment?	NO	
If required, enter the "Uniform Hazardous Waste Manifest" number. N/A		

Consignee: Colorado State University	Carrier: Colorado State University
Environmental Health Services	Environmental Health Services
<input type="checkbox"/> Radioactive Waste Facility	Fort Collins, CO 80523-6021
<input type="checkbox"/> Radioactive Storage and Decay Facility	
<input type="checkbox"/> Mixed Waste Facility	
Fort Collins, CO 80523-6021	
Contact James P. Abraham, RSO	Contact Earlie Thomas, Director EHS
Phone (970) 491-6745	Phone (970) 491-6745
Radioactive Materials License No. Colorado 002-19	Driver's Signature Accepting Shipment

CERTIFICATION: This is to certify that the herein-named materials are properly classified, described, packaged, labeled, marked and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.

Authorized Signature: _____ Date: _____

Codes for US DOT **PROPER SHIPPING NAMES** (Name Code)

- A. Radioactive material, excepted package limited quantity of material, 7, UN2910
- B. Radioactive material, excepted package - instruments and articles, 7, UN2910
- C. Radioactive material, excepted package - EMPTY packaging, 7, UN2910
- D. Radioactive material, low specific activity, n.o.s., 7, UN2912
- E. Radioactive material, n.o.s., 7, UN2982



RF-14C RADIOACTIVE SHIPMENT RECORD (con't)

Colorado State University
 Environmental Health Services
 Fort Collins, CO 80523-6021
 (970) 491-6745 Fax 491-4804

Record No.

Date: _____

Emergency Phone Number
 CSU Radiation Control Office
491-4835

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Item No.	IDENTIFICATION No. of PACKAGE	US DOT Name Code	DOT Label "Radioactive"	LSA/SCO Class	Transport Index	Volume (Gallons)	Weight (Pounds)
1		A	Limited Quantity	N/A	0		
Individual RADIONUCLIDES			Total ACTIVITY SI Units mCi		Physical and Chemical Form		
				5.8E-4	Solid Sanitary Sewer Pipe		

Item No.	IDENTIFICATION No. of PACKAGE	US DOT Name Code	DOT Label "Radioactive"	LSA/SCO Class	Transport Index	Volume (Gallons)	Weight (Pounds)
2		A	Limited Quantity	N/A	0		
Individual RADIONUCLIDES			Total ACTIVITY SI Units mCi		Physical and Chemical Form		

Item No.	IDENTIFICATION No. of PACKAGE	US DOT Name Code	DOT Label "Radioactive"	LSA/SCO Class	Transport Index	Volume (Gallons)	Weight (Pounds)
3		A	Limited Quantity	N/A	0		
Individual RADIONUCLIDES			Total ACTIVITY SI Units mCi		Physical and Chemical Form		

Item No.	IDENTIFICATION No. of PACKAGE	US DOT Name Code	DOT Label "Radioactive"	LSA/SCO Class	Transport Index	Volume (Gallons)	Weight (Pounds)
4		A	Limited Quantity	N/A	0		
Individual RADIONUCLIDES			Total ACTIVITY SI Units mCi		Physical and Chemical Form		

SIGNATURE - Authorized consignee acknowledging receipt of shipment: _____

Date: _____

James P. Abraham – Radiation Safety Officer
Environmental Health Services
Colorado State University
Fort Collins, Colorado 80523-6021
Off: 970-491-3736 Fax: 970-491-4804
jimabe@lamar.colostate.edu



RF-14D Carrier Training

Safety Training

- General Awareness
- Emergency Response
- Measures to protect employee
- Methods and procedures to avoid accidents
- Other current training

I have been advised of the hazards contained within this shipment and I have been briefed on the items listed above.

Carrier Name: _____

Signature of Carrier: _____

Date of Training: _____

***Safety training required for non-CSU personnel to transport limited quantity material by land.

RF-14E COMMON CARRIER SHIPMENT OF RADWASTE

Instructions: Use this checklist for LSA or Type A quantities of radioactive wastes to be shipped by common carrier. Unless otherwise indicated, all references are to U. S. Department of Transportation regulations, found in Title 49 of the Code of Federal Regulations (49 CFR). Obtain the contents of the waste containers from the RCO database. Initial each item upon completion or verification. The person responsible for the shipment shall sign and date the check list after all items have been completed. The completed checklist shall be submitted to, approved and retained by the RCO.

Initials **Type A Containers. Markings and Labels**

- _____ DOT specification 7A, Type A package (or Type B if A2 quantity is exceeded). [173.425(a)]
- _____ On each reconditioned drum, the reconditioner's ID number and drum certification date has been marked within 10 inches of the opening. [173.28]
- _____ All drum lids are provided with gaskets and fit securely: [173.475]
- _____ Each container shall be secured with a seal that is not readily breakable as evidence that the package has not been opened. [173.412(b)]
- _____ Each container shall be marked with lettering at least 1/2-inch high: "USA DOT-7A, TYPE A" and with the name and address (or registered symbol) of the person making the specification marking. [178.350, 173.24(c)(1)]
- _____ Two radioactive material labels, of the type currently authorized, and marked with the quantity and units of activity, are to be affixed to opposite sides of the package. [172.4031]
- _____ Each container shall be marked with lettering at least 1/2-inch high: "RADIOACTIVE MATERIAL, N.O.S. UN2982". [172.101, 172.301]
- _____ For mixed wastes containing flammable liquids in containers of more than 1 pint capacity, each package shall be marked with the following: HAZARDOUS WASTE LABEL (RF-13I), including "THIS END UP" and arrows pointing up, and a "FLAMMABLE LIQUID" label. [172.312]

LSA Containers. Markings and Labels

- _____ Strong, tight package that will not leak during conditions normally incident to transportation. [173.24 and 173.425]
- _____ All drum lids are provided with gaskets and fit securely. [173.475]
- _____ Each container shall be marked with lettering at least 1/2-inch high: "RADIOACTIVE MATERIAL, LSA, N.O.S. UN2912". [172.101, 172.301]
- _____ For mixed wastes containing flammable liquids in containers of more than 1 pint capacity, each package shall be marked with the following: HAZARDOUS WASTE LABEL (RF-13I), including "THIS END UP" and arrows pointing up, and a "FLAMMABLE LIQUID" label. [172.312]

RF-14D COMMON CARRIER SHIPMENT OF RADWASTE

(Continued)

Initials

General for Any Container

_____ Containers shall be in good physical condition with no evidence of damage, corrosion or leakage. [173.24, 173.475]

_____ All metal drums with a capacity of 55 gallons or greater shall have a 5/8 inch or larger bolt for securing the closure ring. Bolt should be torqued to approximately 45 foot-pounds. (US Ecology recommended)

_____ All metal containers shall have an intact heavy duty closure device when presented for disposal. Wooden boxes shall be banded with metal bands. (US Ecology Washington license)

_____ All markings shall be durable, legible, displayed on a background of sharply contrasting color, unobscured and located away from any other marking (e.g. advertising) [172.304]

_____ Each container weighing more than 110 pounds shall be clearly marked with the gross weight and unit of measurement (pounds).

_____ For shipments directly to the burial ground operator/broker, the waste class shall be marked on each container in lettering more than 1/2 inch high. Choices: **Class A Unstable** (most likely), Class A Stable, Class B or C. [10 CFR 61.57 and US Ecology Washington license] Shipments to a processing broker need not be marked with waste class.

Radiation Survey

Exposure rates measured with survey instrument: _____

Ser. No.: _____ Calibration date: _____

Maximum at surface = _____ mR/hr; at 1 meter = _____ mR/hr

_____ Less than 200 mR/hr at all points on the surface of the container. Transport index does not exceed 10, i.e. less than 10 mR/hr at 1 meter. [173.441 (a)]

Contamination measured with survey instrument: _____

Ser. No.: _____ Efficiency: _____ Calibration date: _____

Count rates (cpm or cps): Gross: _____ Background: _____ Net: _____

_____ Less than 0.3 nCi (660 dpm) alpha and less than 3 nCi (6600 dpm) beta-gamma removable contamination **per wipe of 300 cm²**. [173.443(a)]

Surveyed by: _____

RF-14F EXCLUSIVE-USE VEHICLE SHIPMENT OF LSA RADWASTE

Instructions: This checklist should be used for all radwaste or mixed waste shipments to be made by exclusive-use vehicles. The checklist for the exclusive-use vehicle RF-54T shall also be completed. Unless otherwise indicated, all references are to U. S. Department of Transportation regulations, found in Title 49 of the Code of Federal Regulations (49 CFR). Initial each item upon completion or verification. The person responsible for the shipment shall sign and date the check list after all items have been completed. The completed checklist shall be submitted to, approved and retained by the RCO.

<u>Initials</u>	<u>Contents</u>
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	The contents of the shipment will be obtained from the RCO database and need not be entered on this checklist. However, the contents shall be verified to meet the criteria for LSA.
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	Contents of all containers meet the LSA criteria. If not, use RF-54R.
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<u>Initials</u>	<u>Containers</u>
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	All containers are strong, tight packages that will not leak during conditions normally incident to transportation. [173.24 and 173.425]
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	All containers are in good physical condition with no evidence of damage, corrosion or leakage. [173.475]
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	All drum lids are provided with gaskets and fit securely. [173.475]
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	All metal drums with a capacity of 55 gallons or greater shall have a 5/8 inch or larger bolt for securing the closure ring. Bolt should be torqued to approximately 45 foot-pounds. (US Ecology recommended)
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	All metal containers shall have an intact heavy-duty closure device when presented for disposal. Wooden boxes shall be banded with metal bands. (US Ecology Washington license)
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<u>Initials</u>	<u>Labels and Markings</u>
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	All markings shall be durable, legible, displayed on a background of sharply contrasting color, unobscured and located away from any other marking (e.g. advertising) [172.304]
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	Each container is usually marked with lettering at least 1/2-inch high: "RADIOACTIVE MATERIAL, LSA, N.O.S. UN2912". [172. 101, 172.301] However, for LSA materials shipped in an exclusive-use vehicle, the LSA label on each package is not required. [172.400(b)(10)]
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	If the consents include flammable liquids in containers of more than 1 pint capacity, each package shall be marked with the following: "THIS END UP" and an arrow pointing up, and a "FLAMMABLE LIQUID" label. [172.312]
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	Each container weighing more than 110 pounds shall be clearly marked with the gross weight and unit of measurement (pounds).
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RF-14E EXCLUSIVE-USE VEHICLE SHIPMENT OF LSA RADWASTE (Continued-2)

_____ For shipments directly to the burial ground operator/broker, the waste class shall be marked on each container in lettering more than 1/2 inch high. Choices: **Class A Unstable** (most likely), Class A Stable, Class B or C. [10 CFR 61.57 and US Ecology Washington license] Shipments to a processing broker need not be marked with waste class.

Radiation Survey

Exposure rates measured with survey instrument: _____

Ser. No.: _____ Calibration date: _____

Maximum at surface = _____ mR/hr; at 1 meter = _____ mR/hr

_____ Less than 200 mR/hr at all points on the surface of the container. Transport index does not exceed 10, i.e. less than 10 mR/hr at 1 meter. [173.441 (a)]

Contamination measured with survey instrument: _____

Ser. No.: _____ Efficiency: _____ Calibration date: _____

Count rates (cpm or cps): Gross: _____ Background: _____ Net: _____

_____ Less than 0.3 nCi (660 dpm) alpha and less than 3 nCi (6600 dpm) beta-gamma removable contamination **per wipe of 300 cm²**. [173.443(a)]

Surveyed by: _____

Shipping Papers and Other Paperwork

_____ Verify there is a signed Certification form for the Site Use Permit.

_____ Verify that the listing of the contents of all containers is available from the RSO database.

_____ On the front sheet of the manifest, and on the bill of lading, enter the proper shipping name and hazard class, and number of packages of each class. [172.202 and 172.203(d)], e.g.:

"Radioactive material, LSA, n.o.s., UN2912"

"Radioactive material, LSA, n.o.s., flammable liquid, UN2912"

_____ Enter the name and activity of each radionuclide contained in the package, and the physical and chemical form if not special form; entries shall agree with information on the package labels.

_____ Except for Limited Quantities, the following certification shall be printed on the shipping paper and signed by the RSO [172.2041]:

**RF-14E EXCLUSIVE-USE VEHICLE
SHIPMENT OF LSA RADWASTE (Continued-3)**

"This is to certify that the above-named materials are properly classified, described, packaged, marked labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation."

_____ The manifest is complete and signed. Retain a legible copy of the completed shipping papers for the RCO files.

_____ The number of containers listed on the manifest agrees with the physical count of containers loaded.

_____ The consignee has been notified of the expected time of shipment arrival.

Prepared by (signature): _____

Date: _____

RSO approval (signature): _____

Date: _____

**RF-14E EXCLUSIVE-USE VEHICLE
SHIPMENT OF LSA RADWASTE (Continued-4)**

**INSTRUCTIONS TO CARRIER
FOR MAINTAINING CONTROL OF SHIPMENT
BY EXCLUSIVE-USE VEHICLE**

GENERAL INSTRUCTIONS:

This shipment, loaded by consignor, shall be unloaded only by the consignee, or by individuals having radiological training and resources and approved by the consignor. [173.403(i)]

No additional materials, radioactive or otherwise, are to be transported with this consignment. [173.425(b)(4)]

The load shall remain blocked and braced, and the vehicle shall remain placarded, during the entire trip. [173.425(b)(6)]

Persons should not remain unnecessarily in the vehicle [177.842(e)].

EMERGENCY NOTIFICATION:

In the event of an emergency situation where the vehicle configuration shall be changed, the consignor shall be notified prior to initiation of the change:

During normal office hours (8 am to 6 pm, Monday - Friday):
Colorado State University
Environmental Health Services (970) 491-6745

Other hours:
Colorado State University Police (970) 491-6425

ACKNOWLEDGEMENT:

This instruction sheet is to be retained with the shipping papers. [173.425(b)(9)]. Carrier hereby certifies that he has read and understands the instructions for exclusive use shipments.

Name of Carrier: _____

Driver's Signature: _____ Date: _____

RF-14G. EXCLUSIVE USE VEHICLE SURVEY AND DRIVER'S INSTRUCTIONS

All references are to U. S. Department of Transportation regulations, found in Title 49 of the Code of Federal Regulations (49 CFR).

Initials

Transport Vehicle Survey (by Consignor):

_____ Before loading, verify that there is no loose radioactive material in the vehicle.
[173.425(b)(5)]

_____ Maximum exposure rates after loading:

At the external surface of the vehicle:	_____	mrem/hr
Not to exceed 200 mrem/hr [173.441(b)(2)].	_____	mrem/hr
At any point 2 meters from the sides:	_____	mrem/hr
Not to exceed 10 mrem/hr [173.441(b)(3)].	_____	mrem/hr
At any nominally occupied location:	_____	mrem/hr
Not to exceed 2 mrem/hr [173.441(b)(3), 177.842(g)].	_____	mrem/hr

_____ Verify that packages are blocked and braced so that they cannot change position during conditions nominally incident to transportation [173.425(b)(6), 177.842(d)].

_____ "RADIOACTIVE" placards on all 4 sides of vehicle at least 3 inches away from other markings, e.g. advertising. [172.504 Table 1, Note 5].

_____ Additional placards for other hazardous materials applied to vehicle, if appropriate. When the gross weight of all hazardous materials covered by 172.504 Table 2 (flammable, combustible or corrosive liquids, etc.) is less than 1000 pounds, no placard is required for the Table 2 material [172.504(c)]. The "RADIOACTIVE" placards are still required. If the vehicle contains more than 1000 pounds of a Table 2 material, the appropriate placards, e.g. "FLAMMABLE LIQUID", "COMBUSTIBLE LIQUID", etc. shall also be placed on all 4 sides of the vehicle. If the vehicle contains more than one Table 2 material, but less than 5000 pounds of any one class of material, the second set of placards may say "DANGEROUS". [172.504(b)]

_____ Instructions for exclusive-use vehicle have been reviewed with the carrier and provided in writing. [173.441(c,e)]

Checked and Surveyed by: _____

Date & time: _____

RSO Approval (signature): _____

RF-14H COMMON CARRIER SHIPMENT OF TYPE A RADIOACTIVE MATERIAL

Instructions: Use this checklist for any radioactive materials exceeding the limited quantity other than wastes. (Use RF-14A or B for limited quantities; Use RF-54R for radwastes.) Unless otherwise indicated, all references are to DOT regulations (49 CFR). Initial each item upon completion or verification. The person responsible for the shipment shall sign and date the check list after all items have been completed. The completed checklist shall be submitted to, approved and retained by the RCO.

COLORADO STATE UNIVERSITY EMERGENCY RESPONSE TELEPHONE (970) 491-6425

Consignor (Colorado State University Principal User):

Name: _____ Phone: _____

Department: _____ Address: _____

Consignee (Individual and Organization):

Name: _____ Phone: _____

Address: _____

Authorization:

Consignee's License #: _____ Expiration Date: _____

Consignee's RSO: _____ Phone: _____

License copy on file? Yes or

Other verification: _____

Package Contents and Hazardous Material Classification:

Initials Contents

_____ Radionuclide: _____ Activity: _____ mCi Inv# _____ DOT A₂ Limit: _____ mCi

_____ Radionuclide: _____ Activity: _____ mCi Inv# _____ DOT A₂ Limit: _____ mCi

Sum of the Fractions (must be less than 1 if more than one radionuclide) _____

RF-14G COMMON CARRIER SHIPMENT OF TYPE A RADIOACTIVE MATERIAL (Continued-2)

Initials**Container**

_____ DOT specification 7A, Type A package (or Type B if A₂ quantity is exceeded). Complete documentation of tests and an engineering evaluation or comparative data showing that the construction methods, packaging design and materials of construction comply with Specification 7A. [173.415(a), 173.425(a), 178.350]

_____ Containers shall be in good physical condition with no evidence of damage, corrosion or leakage. [173.24, 173.475]

_____ All drum lids are provided with gaskets and fit securely. [173.475]

_____ On each reconditioned drum, the reconditioner's ID number and drum certification date has been marked within 10 inches of the opening. [173.28]

_____ All metal drums with a capacity of 55 gallons or greater shall have a 5/8 inch or larger bolt for securing the closure ring. Bolt should be torqued to approximately 45 foot-pounds.

_____ Each container shall be secured with a seal that is not readily breakable as evidence that the package has not been opened. [173.412(b)]

Labels and Markings

_____ The names and address of both the consignor and the consignee are legibly affixed to each container that is subject to vehicle transfer enroute. [172.301(d)]

_____ Two (2) radioactive material labels, of the type currently authorized, and marked with the quantity and units of activity, are to be affixed to opposite sides of the package; the quantities, units and transport index shall agree with the entries on the shipping papers.

TI \geq 1.0 or \geq 50 mrem/hr at surface requires Yellow III label.

TI \leq 1.0 and \leq 50 mrem/hr at surface requires Yellow II label.

\leq 0.5 mrem/hr at surface (TI not applicable) requires White I label. [172.403]

_____ All markings shall be durable, legible, displayed on a background of sharply contrasting color, unobscured and located away from any other marking (e.g.. advertising) [172.3041]

_____ Each container shall be marked with lettering at least 1/2-inch high: "RADIOACTIVE MATERIAL, N.O.S. UN2982"; this marking should be within six (6) inches of each radioactive material label. [172.101, 172.301(a), 172.406(c)]

RF-14G COMMON CARRIER SHIPMENT OF TYPE A RADIOACTIVE MATERIAL (Continued-3)

_____ Each container shall be marked with lettering at least 1/2-inch high: "USA DOT-7A, TYPE A" and with the name and address (or registered symbol) of the person making the specification marking. [173.24(c)(1), 178.0-2(b), 178.350]

_____ For each container weighing more than 110 pounds, the weight and unit of measurement shall be marked on the container. [172.310(a)(1)]

_____ If the contents include flammable liquids in containers of more than 1 pint capacity, each package shall be marked with the following: "THIS END UP" and an arrow pointing up, and a "FLAMMABLE LIQUID" label. [172.312]

Radiation Survey

Exposure rates measured with survey instrument: _____

Ser. No.: _____ Calibration date: _____

Maximum at surface = _____ mR/hr: at 1 meter = _____ mR/hr

Less than 200 mR/hr at all points on the surface of the container. Transport index does not exceed 10, i.e. less than 10 mR/hr at-1 meter. [173.441(a)]

Contamination measured with survey instrument: _____

Ser. No.: _____ Efficiency: _____ Calibration date: _____

Count rates (cpm or cps): Gross: _____ Background: _____ Net: _____

Less than 0.3 nCi (660 dpm) alpha and less than 3 nCi (6600 dpm) beta-gamma removable contamination **per wipe of 300 cm²**. [173.443(a)]

Surveyed by: _____

Shipping Papers

_____ Enter the proper shipping name and hazard class, and number of packages of each class, on the shipping paper [172.202 and 172.203(d)]:

"Radioactive material, instruments and articles, UN2911"

"Radioactive material, LSA, n.o.s., UN2912"

"Radioactive material, LSA, n.o.s., Flammable Liquid, UN2912"

"Radioactive material, fissile, n.o.s., UN2918"

"Radioactive material, special form, n.o.s., UN2974"

"Radioactive material. n.o.s.. UN2982"

RF-14G COMMON CARRIER SHIPMENT OF TYPE A RADIOACTIVE MATERIAL (Continued-4)

_____ Enter the name and activity of each radionuclide contained in the package, and the physical and chemical form if not special form; entries shall agree with information on the package labels.

_____ Enter the category of label required for the package, and the transport index if the package label is Yellow-II or Yellow-III

Except for Limited Quantities, one of the following certifications shall be printed on the shipping paper and signed by the RSO [172.204]:

_____ For surface shipment by common carrier:

"This is to certify that the above-named materials are properly classified, described, packaged, marked, labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation."

_____ For shipment by cargo aircraft:

"I hereby certify that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, labeled and in proper condition for carriage by air according to applicable national governmental regulations. This shipment is within the limitations prescribed for cargo aircraft only."

_____ For shipment in a passenger-carrying aircraft:

"I hereby certify that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, labeled and in proper condition for carriage by air according to applicable national governmental regulations. This shipment is within the limitations prescribed for passenger aircraft only. The herein-named materials are intended for use in, or incident to, research or medical diagnosis or treatment."

_____ Retain a legible copy of the completed shipping paper for the RCO files.

Vehicle Requirements

_____ Verify that packages are blocked and braced so that they cannot change position during conditions normally incident to transportation. [173.425(b)(6), 177.842(d)]

_____ The sum of the transport index numbers on the vehicle does not exceed 50 [177.842]

Prepared by (signature): _____

Date: _____

RSO approval (signature): _____

Date: _____



BILL OF LADING

James P. Abraham, RSO
Environmental Health Services
Fort Collins, CO 80523-6021
(970) 491-3736
Fax: (970) 491-4804
jabraham@lamar.colostate.edu

Date:

Shipper: **Colorado State University
Environmental Health Services
Fort Collins, CO 80523-6021**

**RF-14I
RQ, RADIOACTIVE MATERIAL, SPECIAL FORM, N.O.S., 7,
UN3332, TYPE "A" PACKAGE, CONTAINING:**

1.85 GBq (50 mCi) Am-241:Be

SS-292

RADIOACTIVE YELLOW II LABEL, TI = (0.6)

******* EMERGENCY CONTACT: (510) 228-9770 (CPN)*******

This is to certify that the above-named materials are properly classified, described, packaged, marked, labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.

SHIPPER

RF-14I (Continued-2) NUCLEAR GAUGE EMERGENCY RESPONSE INFORMATION REQUIRED FOR TRANSPORTATION

(Reference DOT P5800.5 ERG93, and 49CFR)

1) PROPER SHIPPING NAME:

- RQ, RADIOACTIVE MATERIAL, SPECIAL FORM, NOS, 7, UN3332

POTENTIAL HAZARDS

2) HEALTH HAZARDS

- Radiation presents minimal risk to lives of persons during transportation accidents.
- Undamaged packages are safe; damaged packages or materials released from packages can cause external radiation hazards. Contamination is not suspected.
- Packages (cartons, boxes, drums, articles, etc.) identified as “Type A” by marking on packages or by shipping papers contain non-life endangering amounts. Radioactive sources may be released if packages are damaged in moderately severe accidents.
- Packages (large and small, usually metal) identified as “Type B” by marking on packages or by shipping papers contain potentially life-endangering amounts. Because of design, evaluation, and testing of packages, life-endangering releases are not expected in accidents except those to utmost severity.
- Commonly available instruments can detect most of these materials.
- Water from cargo fire control is not expected to cause pollution.

3) FIRE OR EXPLOSION

- Packaging can be consumed without content loss from sealed source capsule.
- Radioactive source capsules and Type B packages are designed to withstand temperatures of 1475⁰F (800⁰C).

EMERGENCY ACTION

4) IMMEDIATE PRECAUTIONS

- **Priority response actions may be performed before taking radiation measurements.**
- **Priorities are life saving, control of fire and other hazards, and first aid.**
- Isolate hazard area and deny entry. Notify Radiation Authority of accident conditions.
- Delay final cleanup until instruction or advice of Radiation Authority.
- Positive pressure self-contained breathing apparatus (SCBA) and structural fire fighters protective clothing will provide adequate protection against internal radiation exposure, by not external radiation exposure.
- **CALL COLORADO STATE UNIVERSITY AT (970) 491-6745 FOR EMERGENCY ASSISTANCE.**

5) FIRE

- Do not move damaged packages; move undamaged packages out of fire zone.
- **Small Fires:** Dry Chemical, CO₂, water spray or regular foam.
- **Large Fires:** Water spray, fog (flooding amounts)

6) SPILL OR LEAK

- **Do not touch damaged packages or spilled materials.**
- Slightly damaged or damp outer surfaces seldom indicate failure of inner container.
- If source is identified as being out of package; stay away and await advice form Radiation Authority.

7) FIRST AID

- Use first aid treatment according to the nature of injury.
- Persons exposed to special form sources are not likely to be contaminated with radioactive materials.

RF-14J SHIPMENT OF ARTICLES OR INSTRUMENTS CONTAINING OR CONTAMINATED WITH RADIOACTIVE MATERIALS

This form is to be completed **for shipment of articles or instruments containing or contaminated with radioactive material to a non-University licensee.** The individual desiring authorization to ship the material shall complete this form and submit it to the RCO's designee for approval **before the material is shipped.**

COLORADO STATE UNIVERSITY EMERGENCY RESPONSE TELEPHONE (970) 491-6425

Consignor (Colorado State University Principal User):

Name: _____ Phone: _____

Department: _____ Address: _____

Consignee (Individual and Organization):

Name: _____ Phone: _____

Address: _____

Authorization:

Consignee's License #: _____ Expiration Date: _____

Consignee's RSO: _____ Phone: _____

License copy on file? Yes or

Other verification _____

Package Contents and Hazardous Material Classification:

<u>Initials</u>	<u>Contents</u>
_____	Radionuclide: _____ Activity: _____ mCi Inv# _____ DOT A ₂ Limit: _____ mCi
_____	Radionuclide: _____ Activity: _____ mCi Inv# _____ DOT A ₂ Limit: _____ mCi
_____	Radionuclide: _____ Activity: _____ mCi Inv# _____ DOT A ₂ Limit: _____ mCi

Sum of the Fractions (must be less than 1 if more than one radionuclide) _____

Initials

- _____ Solid material, special form less than $10^{-2} A_1$ and less than A_1 for package limits [173.425].
- _____ Solid material, normal form less than $10^{-2} A_2$ and less than A_2 for package limits [173.425].
- _____ Liquid material less than $10^{-3} A_2$ and less than $10^{-1} A_2$ for package limits [173.425].
- _____ Tritium gas less than $2 \times 10^{-2} A_2$ and less than $2 \times 10^{-1} A_2$ for package limits [173.425].
- _____ Special form gas less than $10^{-3} A_1$ and less than $10^{-2} A_1$ for package limits [173.425].
- _____ Other form gas less than $10^{-3} A_2$ and less than $10^{-2} A_2$ for package limits [173.425].
- _____ Less than 15 grams ^{235}U . [173.424].
- _____ The package contains no hazardous material other than radioactive material.

Container

- _____ Strong, tight package that will not leak during conditions normally incident to transportation [173.24 and 173.410].
- _____ For liquid material, the closures on the inner container is upright [173.24].
- _____ The inner package is cushioned to prevent breakage or leakage [173.24].
- _____ The package can be easily handled and properly secured in or on a conveyance during transport [173.410].
- _____ Each lifting attachment that is a structural part of the package is designed with a minimum safety factor of three against yielding when used to lift the package in the intended manner, and it is designed so that failure of the lifting attachment under excessive load does not impair the ability of the package to meet other requirements [173.410].
- _____ The external surface, as far as practicable, is free from protruding features and can be easily decontaminated [173.410].
- _____ The outer layer of packaging avoids, as far as practicable, pockets or crevices where water might collect [173.410].
- _____ Each feature that is added to the package does not reduce the safety of the package [173.410].
- _____ The package is capable of withstanding the effects of any acceleration, vibration or vibration resonance that may arise under normal conditions of transport without any deterioration in the effectiveness of the closing devices on the various receptacles or in the integrity of the package as a whole and without loosening or unintentionally releasing the nuts, bolts, or other securing devices even after repeated use [173.410].

_____ The materials of construction of the packaging and any components or structure is physically and chemically compatible with each other and with the package contents. The behavior of the packaging and the package contents under irradiation is taken into account [173.410].

_____ All valves through which the package contents could escape are protected against unauthorized operation [173.410].

For transport by air:

_____ The temperature of the accessible surfaces of the package will not exceed 50 degrees C (122 degrees F) at an ambient temperature of 38 degrees C (100 degrees F) with no account taken for insulation [173.410].

_____ The integrity of containment will not be impaired if the package is exposed to ambient temperatures ranging from -40 degrees C (-40 degrees F) to 55 degrees C (131 degrees F) [173.410].

_____ Packages containing liquid contents will be capable of withstanding, without leakage, an internal pressure that produces a pressure differential of not less than 95 kPa (13.8 lb/in²) [173.410].

Labels and Markings

_____ Names of consignee and consignor on outside of package.

_____ The following statement must be on the package and on the shipping paper: **"This package conforms to the conditions and limitations specified in 49 CFR 173.424 for radioactive material, excepted package-instruments or articles, UN2910."**

_____ If it is to be shipped on a passenger-carrying aircraft, the following certification is required on the shipping paper: **"The above-named materials are intended for use in, or incident to, research or medical diagnosis or treatment."** [172.204(c)]

_____ The outside of the inner package or, if there is no inner packaging, the outside of the packaging itself bears the marking "Radioactive". [173.421 (d)]

Prepared by (signature): _____ Date: _____

Initials

Radiation Survey:

Maximum at 4 inches from instrument or article = _____ mrem hr⁻¹

Maximum at surface of package = _____ mrem hr⁻¹

_____ Less than 0.5 mrem hr⁻¹ at from any point on the surface of the package and less than 10 mrem hr⁻¹ from all points 4 inches from the external surface of the instrument or article. [173.424]

Contamination: _____ dpm cm⁻²

_____ Less than 2.2 dpm cm⁻² alpha and less than 22 dpm cm⁻² beta-gamma removable contamination.

Surveyed by (signature): _____ Date: _____

RSO approval (signature): _____ Date: _____

RF-14K TYPE A PACKAGING TESTS AND REQUIREMENTS (Not for Air Transport and Not Industrial)

Initials

- _____ Strong, tight package that will not leak during conditions normally incident to transportation [173.24 and 173.410].
- _____ For liquid material, the closures on the inner container is upright [173.24].
- _____ The inner package is cushioned to prevent breakage or leakage [173.24].
- _____ The package can be easily handled and properly secured in or on a conveyance during transport [173.410].
- _____ Each lifting attachment that is a structural part of the package is designed with a minimum safety factor of three against yielding when used to lift the package in the intended manner, and it is designed so that failure of the lifting attachment under excessive load does not impair the ability of the package to meet other requirements [173.410].
- _____ The external surface, as far as practicable, is free from protruding features and can be easily decontaminated [173.410].
- _____ The outer layer of packaging avoids, as far as practicable, pockets or crevices where water might collect [173.410].
- _____ Each feature that is added to the package does not reduce the safety of the package [173.410].
- _____ The package is capable of withstanding the effects of any acceleration, vibration or vibration resonance that may arise under normal conditions of transport without any deterioration in the effectiveness of the closing devices on the various receptacles or in the integrity of the package as a whole and without loosening or unintentionally releasing the nuts, bolts, or other securing devices even after repeated use [173.410].
- _____ The materials of construction of the packaging and any components or structure is physically and chemically compatible with each other and with the package contents. The behavior of the packaging and the package contents under irradiation is taken into account [173.410].
- _____ All valves through which the package contents could escape are protected against unauthorized operation [173.410].

The packaging, with contents, must be capable of withstanding the water spray, free drop, stacking and penetration tests prescribed in these instructions. One prototype may be used for all tests if the requirements of the water spray test are met. [173.465].

One prototype was used _____ Prototypes were used

Water Spray Test – This must precede each test or test sequence. Must simulate 2 inches of rain per hour for at least one hour. The time interval for the next test must be such that the water has soaked in to the maximum extent without appreciable drying of the exterior. In the absence of evidence, the interval may be assumed to be two hours if the water is applied from four different directions simultaneously. No time interval may elapse if the water spray is applied from each of the four directions consecutively.

Water applied from four different directions simultaneously Two hour interval used

Water applied from each of the four directions consecutively No time interval required

No degradation of containment observed. (Attach digital photo)

Degradation observed Comments: _____

Free Drop Test – The specimen must drop onto the target so as to suffer maximum damage. The target must be a flat horizontal surface of such mass and rigidity that any increase in its resistance to displacement or deformation upon impact by the package would not significantly increase the damage to the target.

Target material: _____

The height measured from the lowest point of the package to the target must not be less than the distance specified in the following table.

Packaging Mass Kilograms (pounds)	Free Drop Distance	
	Meters	Feet
< 5,000 (11,000)	1.2	4
5,000 (11,000) to 10,000 (22,000)	0.9	3
10,000 (22,000) to 15,000 (33,000)	0.6	2
> 15,000 (33,000)	0.3	1
Liquid Package	≥ 9	≥ 30

Package weight (pounds): _____

Free Drop Distance (Feet): _____

Fissile material: the test required in the above table must be preceded by a free drop from a height of 1 foot on each corner, or in the case of cylindrical packages, onto each of the quarters of each rim.

Free drop on corners Free drop on to each of the quarters of each rim N/A

Fiberboard or Wood Rectangular Packages, 50 kg (110 pounds) or Less: a separate package must be subjected to a free drop onto each corner from a height of 0.3 meters (1 foot).

Free drop on corners N/A

Cylindrical Fiberboard Packages, 100 kg (220 pounds) or Less: a separate package must be subjected to a free drop onto each of the quarters of each rim from a height of 0.3 meters (1 foot).

Free drop on each quarter of each rim N/A

No degradation of containment observed. (Attach digital photo)

Degradation observed Comments: _____

Stacking Test – The load must be applied uniformly to two opposite sides of the package, one of which must be the base on which the package normally rests. The package must be subjected for a period of at least 24 hours to a compressive load equivalent to the greater of the following:

Five times the mass of the actual package;

This test used Mass Used _____ N/A

The equivalent of 13 kilopascals (1.9 pounds per square inch) multiplied by the vertically projected area of the package;

This test used Kilopascals Used _____ N/A

No degradation of containment observed. (Attach digital photo)

Degradation observed Comments: _____

Penetration Test – The package must be placed on a rigid, flat horizontal surface that will not move significantly while the test is performed.

Surface material: _____

A bar 3.2 cm (1.25 inches) in diameter with a hemispherical end and a mass of 6 kg (13.2 pounds) must be dropped and directed to fall with its longitudinal axis vertical, onto the center of the weakest part of the package, so that, if it penetrates far enough, it will hit the containment system. The bar may not be significantly deformed by the test. The height of the drop measured from the lower end to the intended point of impact on the upper surface of the package must be 1 meter (3.3 feet) or greater. For liquid packages, the height of the drop must be 1.7 meters (5.5 feet).

1 meter penetration test for solid package 1.7 meter penetration test for liquid package

No degradation of containment observed. (Attach digital photo)

Degradation observed Comments: _____

RF-14L Bill of Lading
SHIPPING PAPER

Page 1 of 1

To:

From:

Radiation Control Office
Colorado State University
133 General Services Bld.
Fort Collins, Colorado U.S.A.
80523 - 6021

QUANTITY	HAZARDOUS MATERIAL	DESCRIPTION (S.H.I.P.)	WEIGHT

EMERGENCY PHONE NUMBER (970) – 491 – 3736

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.

The above named materials are intended for use in or incident to, research, or medical diagnosis or treatment.

SHIPPER: Colorado State University

PER: James P. Abraham, R.S.O.

RADIOACTIVE MATERIAL, SPECIAL
FORM, N.O.S., 7 UN2974
USA DOT-7A, TYPE A

RADIOACTIVE MATERIAL, SPECIAL
FORM, N.O.S., 7 UN2974
USA DOT-7A, TYPE A

RADIOACTIVE MATERIAL, SPECIAL
FORM, N.O.S., 7 UN2974
USA DOT-7A, TYPE A

RADIOACTIVE MATERIAL, SPECIAL
FORM, N.O.S., 7 UN2974
USA DOT-7A, TYPE A

RADIOACTIVE MATERIAL, SPECIAL
FORM, N.O.S., 7 UN2974
USA DOT-7A, TYPE A

RADIOACTIVE MATERIAL, SPECIAL
FORM, N.O.S., 7 UN2974
USA DOT-7A, TYPE A

RADIOACTIVE MATERIAL, SPECIAL
FORM, N.O.S., 7 UN2974
USA DOT-7A, TYPE A

RADIOACTIVE MATERIAL, N.O.S., 7

UN2982

USA DOT-7A, TYPE A

RADIOACTIVE MATERIAL, N.O.S., 7

UN2982

USA DOT-7A, TYPE A

RADIOACTIVE MATERIAL, N.O.S., 7

UN2982

USA DOT-7A, TYPE A

RADIOACTIVE MATERIAL, N.O.S., 7

UN2982

USA DOT-7A, TYPE A

RADIOACTIVE MATERIAL, N.O.S., 7

UN2982

USA DOT-7A, TYPE A

RADIOACTIVE MATERIAL, N.O.S., 7

UN2982

USA DOT-7A, TYPE A

RADIOACTIVE MATERIAL, N.O.S., 7

UN2982

USA DOT-7A, TYPE A

This package conforms to the conditions and limitations specified in 49 CFR 173.421 for excepted radioactive material, limited quantity, n.o.s., UN2910

This package conforms to the conditions and limitations specified in 49 CFR 173.421 for excepted radioactive material, limited quantity, n.o.s., UN2910

This package conforms to the conditions and limitations specified in 49 CFR 173.421 for excepted radioactive material, limited quantity, n.o.s., UN2910

This package conforms to the conditions and limitations specified in 49 CFR 173.421 for excepted radioactive material, limited quantity, n.o.s., UN2910

This package conforms to the conditions and limitations specified in 49 CFR 173.424 for radioactive material, excepted package-instruments or articles, UN2910

This package conforms to the conditions and limitations specified in 49 CFR 173.424 for radioactive material, excepted package-instruments or articles, UN2910

This package conforms to the conditions and limitations specified in 49 CFR 173.424 for radioactive material, excepted package-instruments or articles, UN2910

This package conforms to the conditions and limitations specified in 49 CFR 173.424 for radioactive material, excepted package-instruments or articles, UN2910