

DEPARTMENT OF TRANSPORTATION

**RADIOACTIVE MATERIAL SHIPMENT
HAZARDOUS MATERIAL GUIDE**

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Shipping Radioactive Materials

Packages prepared for shipment that contain radioactive materials are viewed as hazardous materials shipments. 10 CFR 30.34 (c) states that preparation for shipment and transport of radioactive materials will be in accordance with Part 71 of the Federal Code. Part 71.5 (a) states that no licensee shall transport radioactive material unless they comply with the regulations of the DOT in 49 CFR Parts 170-189. This relates to packaging of byproduct materials, marking and labeling of packages, loading and storage of packages, placarding of the transportation vehicle, monitoring requirements and accident reporting.

Department of Transportation regulations deal only with the Interstate Commerce, regardless, paragraph 71.5 (b) states that even if the transportation is not interstate, that licensees will conform to the standards and requirements of the DOT to the same extent **AS IF** the shipment was interstate.

Consequently, when packages are prepared for shipment, there are a number of items of which the employees should be aware:

1. Packages containing radioactive materials are designated as either NORMAL FORM or LIMITED QUANTITY shipments. The difference is in the amount of the activity that is being shipped. Refer to any Radiopharmacy's limited quantity paperwork that they have available. If these limits are exceeded, then the package is a Normal Form shipment.
2. Normal Form packages require a security seals. This seal can be a nylon tie, paper tube or a device that would show when the integrity of the package has been breached. It would not be advisable to use a padlock since it could not be determined afterward if there was entry into the package.
3. In some instances, the shipping containers must be of a specific design. Normal Form shipments require the use of a "TYPE A" package. The containers must be certified as having passed tests that check a number of things: a drop test, water spray test, compression test and a penetration test. Documentation must be made available of the certification. When "TYPE A" containers are not necessary as in Limited Quantity, the package need only be strong and in good condition.
4. Placards and labels may be needed when shipping certain radioactive packages. The three bladed symbol and words "Caution Radioactive Materials" may need to be on the inside of the package. N.O.S. UN2982 (Normal Form) or UN2910 (Limited Quantity) designations may need to be used. DOT White I, Yellow II or Yellow III diamond shaped labels may be required. Transport index values may need to be entered.
5. Surveys and wipe tests must be conducted on different types of packages.
6. If the contamination or exposure limits are exceeded, your RSO should be contacted. Time, distance and shielding should always be considered.

7. The transport index may need to be used. This is the survey measurement taken at one meter from the surface of the package and entered onto the Yellow II or Yellow III label (only) in the appropriate location. It is the exposure rate in mr/hr but entered in as only a dimensionless number rounded up to the nearest tenth.
8. All paperwork must be completed as is always the case. Bill of Lading and Shipper's Certificate are part of these. A Bill of Lading is needed to identify all information about the contents of the shipment. The Shipper's Certificate is a signed statement that all has been prepared in accordance with DOT regulations.

RETURN OF PACKAGES CONTAINING RADIOACTIVE MATERIALS

Below are several scenarios that can serve as examples of various shipments that are typically performed in a hospital situation:

1. RETURN OF A PACKAGE CONTAINING NO RADIOACTIVE MATERIALS

- A. A package may be returned to a supplier such as a radiopharmacy without any additional survey requirements or labeling if there are no radioactive materials in the package. This does not constitute a hazardous materials shipment but addresses what should be done with the shipping cases that radiopharmacies use when delivering doses to hospitals.

2. RETURN OF "LIMITED QUANTITY" PACKAGES

- A. Package contains no more than Limited Quantities
 - a. Wipe test the external surface of the package, not to exceed 22 dpm per square centimeter tested over 300 square centimeters. That is the action limit of 6600 dpm per 300 square centimeters cannot be exceeded.
 - b. Survey at the surface (exposure cannot be $> .5$ mr/hr)
 - c. Remove the exterior placards or other labeling.
 - d. Inside of package must contain "Radioactive Materials" sign (on syringe shields or Molybdenum/Technetium generators).
 - e. Package must be adequate and in good condition but need not be a "TYPE A" container. However, the "TYPE A" container used by the radiopharmacy can still be used for this purpose.

3. PACKAGE CONTAINS MORE THAN LIMITED QUANTITIES - (NORMAL FORM)

- A. Survey the surface of the package (not to exceed 0.5 mrem/hr. Survey one meter (not greater than background mrem/hr) then; display White Label I transport sign.

OR:

- B. Survey the surface of package (between 0.5 and 50 mrem/hr). Survey one meter (no greater than 1 mrem/hr) then; display a Yellow II Group Transport sign.

OR:

- C. Survey the surface of the package (between 50 and 200 mrem/hr), then; display a Yellow III Transport Group Label.
- D. Group II or III signs – determine the transport index and enter.
- E. Wipe test external surface (not to exceed 6600 dpm/300 square centimeters).
- F. Sign Shipper's Certificate.

OUTER PACKAGE INFORMATION

Label Categories for Shipping Radioactive Materials

Radioactive "White Label I "	Radiation Limit: Surface not to exceed 0.5 mrem/hr 1 meter: NA
Radioactive "Yellow Label II"	Radiation Limit: > 0.5 - not to exceed 50 mrem/hr 1 meter > 0 not to exceed 1.0 mr/hr
Radioactive "Yellow Label III"	Radiation Limit: Surface >50 not to exceed 200 mrem/hr 1 meter \geq 10 mR/hr

Note that for a "Yellow II" or "Yellow III" there is a requirement of a Transport Index (TI) that should be placed in the appropriate location of the label. This is the reading taken with a survey meter at one meter from the surface of the box and is the highest reading obtained. It is not necessary to affix the mr/hr label at the end of the reading. So an example of a Transport Index would be 0.7. This indicates to the recipient that their one meter reading should not exceed the TI or else there may be external contamination of the package.

There are labeling exceptions for certain "limited quantities" of radioactive material.

For the transporting of radioactive materials by motor vehicle, if there are one or more packages bearing "Radioactive yellow III" labels, placards (signs) showing the symbol and the word "RADIOACTIVE" must be posted on all four sides of the vehicle.

CONTAMINATION LEVEL LIMITS

The exterior of the package must not have significant removable contamination. The maximum permissible limits averaged over a maximum 300 cm² area are as follows:

uCi / cm²

10 E – 5

10 E – 6

dpm / cm²

22 (for Beta-Gamma emitters)

2.2 (for alpha emitters)

Reference for the above can be found in 10 CFR 71.87 (l) (1) Table V.

LIMITED QUANTITY RETURNS TO A RADIOPHARMACY

As a shipper of hazardous (radioactive) materials the Department of Transportation requires that the following be performed when you prepare a package for delivery to a radiopharmacy.

1. Make sure that the total package does not exceed the lowest activity in the table below. As an example, if Tc-99m and Tl-201 were being shipped in the same package, only 10 mCi of total activity could be shipped as Limited Quantity.

Radionuclide	Max. Activity in mCi	A1 Special Ci	A2 Normal Ci
Co-57	9	90	600
Cr-51	60	600	600
Ga-67	10	100	100
I-123	5	50	50
I-125	7	1000	70
I-131	1	40	10
In-111	2.5		
Mo-99	2	100	20
P-32	3	30	30
Sr-89	1		
Tc-99m	10	100	100
Tl-201	20	200	20
Xe-133	1000	1000	1000

Limited Quantities for solid form: Multiply A_2 by 10^{-3}

Limit Quantities for liquid form: Multiply A_2 by 10^{-4}

2. Place only the lead pigs received from the radiopharmacy in the suitcase, since by regulation, they can only receive what was shipped by that pharmacy.
3. Ensure that there is no reading that exceeds 0.5 mrem/hr at any location on the package. This survey must be done on all six (6) sides of the package.
4. Perform a wipe test of the external surface of the container making sure that you wipe at least 300 cm². Analysis of the wipe should yield no more than 6600 dpm. If it does, then you must hold the package for decay.
5. If the package activity, survey and wipe test are within limits, then the placard signs must be reversed. Place the package in the designated area for return.

TRAINING REQUIREMENTS FOR HAZARDOUS MATERIALS EMPLOYEES

In accordance with 49 CFR 172.702 employers are required to make sure that employees who are involved in the shipping of hazardous radioactive materials are trained and tested on the training subjects that are contained in Section 172.704. This training is required for each employee every three (3) years. Documentation of the training and testing must be available for inspection by the State, NRC or D.O.T. The following is a summary of the items that need to be covered during the training process:

GENERAL AWARENESS

Each employee should be familiar with identifying a radioactive shipment.

FUNCTION SPECIFIC TRAINING

Each employee should receive this training that is specific to the situation (i.e., "limited quantities" or less than "limited quantities").

SAFETY TRAINING

This training should include emergency response to include telephone numbers of State/Federal Officials to notify as well as local officials. The employee should also be knowledgeable about the measures to protect themselves from unnecessary exposure. A review of time, distance, and shielding concepts would be appropriate.

The training described above is required every three (3) years and documentation must be kept on file for inspection as long as the employee is with the organization. The documentation of training must consist of the following:

- Employee name
- Most recent training date
- Description and copy of the material used in training
- Name and address of person providing training
- Certification that the employee has been tested.

The above is a summary of the Regulations found in 49 CFR 172.704.

DEFINITIONS AND TERMINOLOGY

FISSILE MATERIAL	Plutonium-238, 239, 241, Uranium-235 or any material containing these.
LIMITED QUANTITIES	A quantity of radioactive material which does not exceed the limits specified in 173.423. Limited quantities and certain radioactive instruments are excepted from specification packaging, shipping papers and label requirements (173.421) but are still subject to certain requirements (173.421-424).
SHIPPING PAPERS	Describes the name of nuclide, physical & chemical form, activity, category label, transport index.
SHIPPER'S CERTIFICATE	A statement that indicates that the materials are properly classified, described, packaged, marked and labeled for transport per DOT.
SPECIAL FORM	Those materials which, by nature of their physical form, if released from a package might present some direct radiation hazard but present little hazard from contamination.
NORMAL FORM	Those materials which do not meet requirements of special form.
TRANSPORT INDEX	A number placed on Yellow labels to denote the degree of control to be exercised by the carrier. Measured at 1 meter from surface.
TYPE A PACKAGE	Package that has passed tests described in 173.465

REFERENCES

10 CFR 30.34, Code of Federal Regulations

49 CFR Part 100-177, Code of Federal Regulations

Regulatory Guide 10.8, "Guide in the Preparation of a Radioactive Materials License"

"A Review of The Department of Transportation Regulations for Transportation of Radioactive Materials," Rev., Summer, 1983

TRAINING DOCUMENT FOR SHIPPING RADIOACTIVE MATERIALS

Name of Facility: _____

Employee's Name: _____

Date of Training: _____

Name & Address of Person Providing Training:

1. How often is HAZMAT training required?
 - a. Once a year
 - b. Every two years
 - c. Every three years
 - d. When a new employee is hired

2. Radioactive materials are considered hazardous because:
 - a. They require special handling by trained employees.
 - b. They are potentially dangerous to the public.
 - c. They are defined by the DOT as hazardous.
 - d. All of the above

3. The Transport Index (TI) is the exposure rate in mrem/hr:
 - a. At the surface of a package.
 - b. One meter from the surface of the package
 - c. At the surface of the vehicle that is transporting it
 - d. At 3 feet from the surface of the package

4. If the surface of a package is measured to be 16 mrem/hr, and the 1 meter reading is 1.7 mrem/hr, what is the appropriate DOT label on the box?
 - a. White I
 - b. Yellow II
 - c. Yellow III
 - d. Reading is low, no label required.

5. A Shipper's Certificate is:
 - a. A document showing a package design is certified Type A
 - b. A bill of lading (shipping papers)
 - c. A statement that all has been prepared for shipping in accordance with DOT regulations.
 - d. A certificate indicating successful training.

TRAINING DOCUMENT FOR SHIPPING RADIOACTIVE MATERIALS

Name of Facility: _____

Employee's Name: _____

Date of Training: _____

6. Under normal conditions, the maximum exposure rate at 1 meter from a Type A package cannot exceed:

- a. 100 mr/hr
- b. 10 mr/hr
- c. 200 mr/hr
- d. 1 mr/hr
- e. None of the above

7. A White I, Yellow II and Yellow III, all require the determination of a Transport Index.

TRUE OR FALSE

8. Limit quantity packages require a security seal.

TRUE OR FALSE

9. Limited quantity shipments require a Type A package.

TRUE OR FALSE

10. The DOT rules are found in:

- a. 10 CFR Part 49
- b. 49 CFR Part 172
- c. Regulatory Guide 10.8
- d. None of the above.

SCORE _____ Right of 10.

