



M E R R T T

Assessing Package Integrity

notes

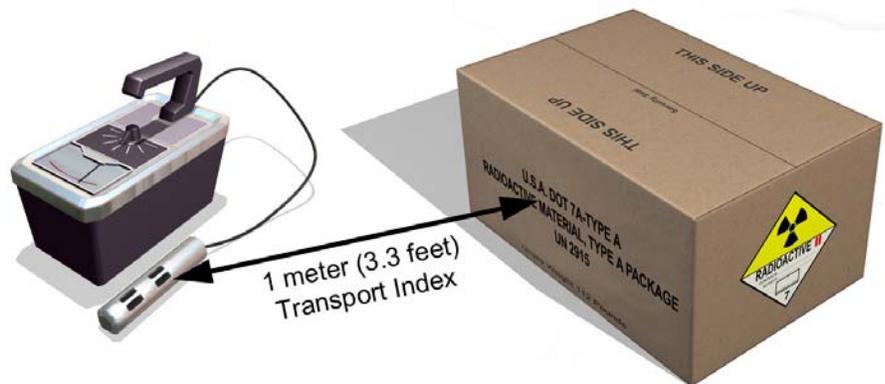
RADIATION LEVELS ASSOCIATED WITH RADIOACTIVE MATERIAL PACKAGES

The U.S. Government regulates domestic shipments of radioactive material. The U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Transportation (DOT) share this responsibility. The areas regulated include the packaging, contents, radiation levels, and various transport requirements, including labeling and shipping papers.

Before transport, shippers of radioactive material are required to check the radiation levels of packages to ensure that all levels are within allowed limits. Radiation levels are checked on the packaging surface and at one meter (3.3 feet) from the package.

TRANSPORT INDEX (TI)

The transport index, often called the TI, is the dimensionless number¹ placed on the label of a package to designate the degree of control to be exercised by the carrier during transportation. The TI is equal to the maximum radiation level in mrem/hour at one meter from an undamaged package. The TI can be an indicator for determining the external radiation hazard of an undamaged package and can be a starting point for determining whether or not damage has occurred.



¹ Dimensionless number means that there are no units of measure (e.g., mrem) associated with the transport index.



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Radioactive White-I

The Radioactive White-I label is attached to packages with extremely low levels of external radiation. The maximum contact radiation level associated with this label is 0.5 mrem/hour.



Radioactive Yellow-II

The Radioactive Yellow-II label is attached to packages with external contact radiation levels ranging from greater than 0.5 mrem/hour to no more than 50 mrem/hour.

The Radioactive Yellow-II label also has a box for the transport index. The maximum allowable transport index for this label is 1.





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Radioactive Yellow-III

The Radioactive Yellow-III label is attached to packages with external contact radiation levels ranging from greater than 50 mrem/hour to a maximum of 200 mrem/hour.

The maximum allowable transport index for this label is 10.



notes

Category of Label	Maximum Contact Dose Rate	Maximum Dose Rate at 1 Meter
White-I	0.5 mrem/hr	N/A
Yellow-II	50 mrem/hr	1 mrem/hr
Yellow-III	200 mrem/hr	10 mrem/hr

RADIOACTIVE MATERIAL LABELS

0.5 mrem/hr max. on contact with package.

50 mrem/hr max. on contact with package.
1 mR/hr max. @ 3.3 feet from package.

200 mrem/hr max. on contact with package.
10 mR/hr max @ 3.3 feet from package.
(requires vehicle placarding)

Markings on exterior of package will list the Proper Shipping Name, UN ID Number, and package type if IP, Type A, or Type B. IP and Type A Packages contain non life-endangering amounts of radioactive material. Type B Packages are built to withstand severe accident conditions.





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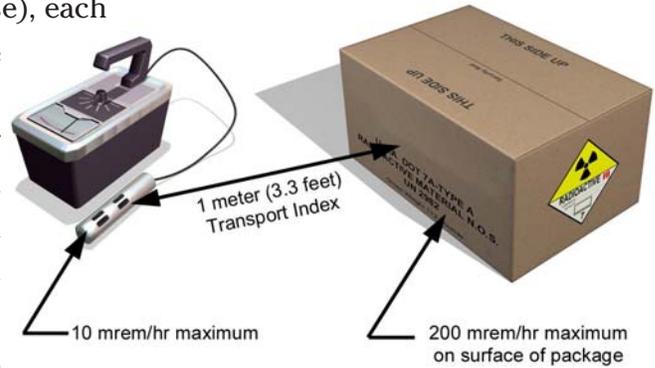
notes

ASSESSING PACKAGE AND VEHICLE RADIATION LIMITS

Radiation Limits on Packages in Non-exclusive Use Shipments

When radioactive material is transported under normal conditions (non-exclusive use), each

package must be designed and prepared for shipment so that the maximum radiation level does not exceed 200 mrem/hour at



any point on the external surface of the package and the transport index does not exceed 10. When assessing a package's integrity at an accident scene, you can use this information as a baseline for determining if damage has occurred to the package. For example, a dose rate reading of 250 mrem/hour on contact with the exterior of a package could indicate potential damage.



Additionally, you should not expect to see radiation dose rates on the surface of the **vehicle** transporting the material that are greater than the limits allowed for the packages inside the vehicle. An exception might occur if several packages with dose rates close to 200 mrem/hour were located near the exterior surface of a vehicle; in such a case, you may see a dose rate reading on the exterior of the vehicle somewhat above 200 mrem/hour.



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Checking Packages for External Contamination

If a package appears to be breached or you suspect it may be breached, you can check for the presence of removable contamination by taking a smear of the package. Removable contamination is defined as the radioactive material that can be transferred from a surface by rubbing with moderate pressure. The smear (or wipe/swipe test) is the universal method of assessing removable contamination. A small cloth, filter paper, or fiberglass disk is used to “wipe” an area or object suspected of being contaminated. A smear should cover a minimum surface area of 100 cm² (approximately equal to a square measuring 4" by 4"). Smears should be dry and taken using moderate pressure. Protective clothing should always be worn when taking smear samples to minimize the chance of personnel contamination.

Individual smear samples should be kept separate to avoid cross contamination. Smear packets (similar to the one pictured at right) make this easy and are available from a variety of vendors. If pieces of cloth or paper towel are used, they can



be kept separate by using plastic storage bags. Data should be maintained indicating the date and location of each smear sample.





Check Your Understanding

1. An undamaged package with a Radioactive White-I label can have a maximum radiation level of _____ mrem/hour at the surface of the package.
 - a) 50 mrem/hour
 - b) 200 mrem/hour
 - c) 0.5 mrem/hour
 - d) 20 mrem/hour
2. How does the shipper obtain the transport index for a package?
 - a) By taking the maximum radiation level (measured in mrem/hour) at one meter from the undamaged package.
 - b) By taking the maximum weight of the package divided by the radiological dose rate.
 - c) By taking the contact dose rate on the package's inner container.
 - d) By taking the square root of the total number of packages allowed on the shipment.
3. The Radioactive _____ label is attached to packages with external radiation levels ranging from greater than 50 mrem/hour to a maximum of 200 mrem/hour.
4. The maximum radiation level on packages in non-exclusive use vehicles is _____ mrem/hour.
5. The maximum contact radiation level allowed on packages transported inside exclusive use closed transport vehicles is _____ mrem/hour.

ANSWERS

1. c
2. a
3. Yellow-III
4. 200
5. 1,000

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