


- What is not covered in this presentation:**
- ◆ LSA or SCO shipments (mostly radioactive waste)
 - ◆ Exclusive Use Shipments – required for Yellow III under 173.441(b)
 - ◆ Fissile Material Shipments (Pu and U)
 - ◆ Highway Route Controlled Quantities (HRCO Shipment = >3000 times A value)
 - ◆ Type B Shipments

1. WHO REGULATES WHAT MATERIAL

Domestic Shipments
 USDOT and NRC
 Harmonization with:
 IAEA (International Atomic Energy Agency)
 ICAO (International Civil Aviation Organization)
 IATA (International Air Transport Association) 

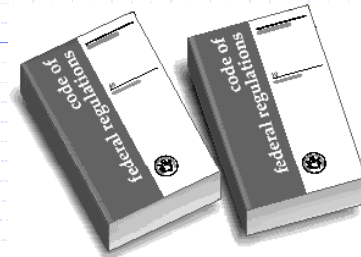
- ## History
- ◆ DOT act of 1966
 - ◆ Atomic Energy Act of 1954
 - ◆ 1979 Memorandum of Understanding

- ## DOT
- ◆ Regulates safety in transportation of all HAZMAT
 - ◆ Regulates Type A and Industrial packages (IP)
 - ◆ Issues certificates of competent authority for international shipments

- ## NRC
- ◆ Regulates safety in receipt, possession, use and transfer of byproduct material
 - ◆ Regulates Type B and fissile packages
 - ◆ Transportation safeguards
 - ◆ Investigates accidents/incidents
 - ◆ Technical advisor to DOT

Types of Radioactive Shipments

DOT		NRC		
Not Regulated in Transport	Limited Quantity of Class 7	Type A Quantities	Type B Quantities	Highway Route Controlled Quantity
less than values specified in the table of 173.436	49 CFR 173.421-426	Limited to A_1 and A_2 Values	Greater than A_1 and A_2 Values	3000 A_1 or 3000 A_2 or 27,000 Ci (whichever is least)



The U.S. DOT and NRC have primary responsibility for the regulation of radioactive materials transport in the United States. These regulations are found in CFR Titles 49 and 10, respectively.

International Regulations

- ◆ IAEA TS-R-1 regulations
- ◆ IATA 45th Edition of DGR Radiation Section
- ◆ Voluntary Compliance Date: 2/25/04
- ◆ Effective Date: 10/1/04

2. Training Requirements

- ◆ Who needs training?

Each hazmat employee who assists in the preparation and delivery of radioactive material
(49 CFR 172.702 – 704)

Training Requirements (cont.)

- ◆ Training must ensure that employee:
 - Is familiar with general provisions of DOT regulations
 - Able to recognize and identify hazardous materials
 - Is knowledgeable of DOT requirements that pertain specifically to the functions they perform
 - Is knowledgeable in emergency self protection measures and accident prevention methods and procedures
 - Practices security awareness

Training Requirements (cont.)

- ◆ **Security awareness training.** No later than the date of the first scheduled recurrent training after March 25, 2003, and in no case later than March 24, 2006, each hazmat employee must receive training that provides an awareness of security risks associated with hazardous materials transportation and methods designed to enhance transportation security. This training must also include a component covering how to recognize and respond to possible security threats. After March 25, 2003, new hazmat employees must receive the security awareness training required by this paragraph within 90 days after employment.

Training Requirements (cont.)

- ◆ **Security Plan** (49 CFR 172.800) Required for quantity of hazardous material that requires placarding
- ◆ **In-depth security training.** By December 22, 2003, each hazmat employee of a person required to have a security plan in accordance with subpart I of this part must be trained concerning the security plan and its implementation. Security training must include company security objectives, specific security procedures, employee responsibilities, actions to take in the event of a security breach, and the organizational security structure.

Security Awareness

- ◆ Find vulnerabilities
- ◆ Employee background checks
- ◆ Training your employees
 - Ask questions
 - Watch for suspicious people
 - Report non-authorized personnel
 - Keep areas locked when not in use

Training Requirements

- ◆ How often is training required?
 - **Initial Training: Must be completed within 90 days after employment, and employee must be supervised prior to completion of training**
 - **Recurrent Training: Employee shall receive refresher training every THREE YEARS** Q4

Training Requirements

- ◆ Training Records
 - Hazmat employee name
 - Most recent training completion date
 - Description, copy, or the location of training materials
 - Certification that the employee has been trained and tested

3. Radioactive Materials Definitions Under 49 CFR 171

Hazard Class

The category of hazard assigned to a hazardous material under the definitional criteria of Part 173 of this subchapter and the provisions of the 172.101 Table. A material may meet the defining criteria for more than one hazard class but is assigned to only one hazard class

All radioactive material shipments are considered
CLASS 7

Q5

HAZMAT EMPLOYEE

A person who is employed by a hazmat employer and who, in the course of employment, directly affects hazardous materials transportation safety. This term includes an owner-operator of a motor vehicle which transports hazardous materials in commerce. This term also includes an individual, including a self-employed individual, employed by a hazmat employer who, during the course of employment:

- Loads, unloads, or handles hazardous materials
- Manufactures, tests, reconditions, repairs, modifies, marks, or otherwise represents containers, drums, or packaging as qualified for use in the transportation of hazardous materials.
- Prepares hazardous materials for transportation
- Is responsible for safety or transporting hazardous materials
- Operates a vehicle used to transport hazardous materials

Radioactive Material

Any material containing radionuclides where both the activity concentration and the total activity in the consignment exceed the values specified in the table in Sec. 173.436 or values derived according to the instructions in Sec. 173.433.

(pages 54 to 59 of narrative) O6

LIMITED QUANTITY

When specified as such in a section applicable to a particular material, means the maximum amount of a hazardous material for which there is a specific labeling or packaging exception.

Solids : 1/1000 of A_2 values

Liquids: 1/10,000 of A_2 values

Reportable Quantity (RQ)

"For the purposes of this subchapter means the quantity specified in Column 3 of the appendix to 172.101 for any material identified in Column 1 of the appendix."

If the activity of the material being shipped in a container is greater than the limit for a Reportable Quantity, the container must indicate this. If there is an accident with an RQ the U.S. Coast Guard National Response Center must be contacted at (800)-424-8802

(pages 42 & 43 of narrative) O7

Tc-99m – 100 Ci, I-131 – 10 mCi, Cs-137 – 1 Ci

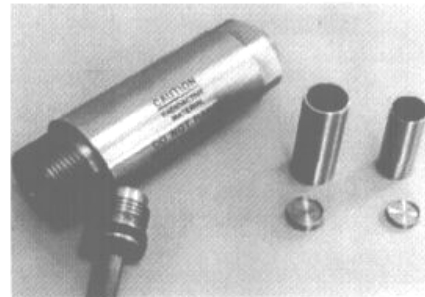
Special Form Class 7 (radioactive) material

Class 7 (radioactive) material which satisfies the following conditions:

1. It is either a single solid piece or is contained in a sealed capsule that can be opened only by destroying the capsule
2. The piece or capsule has at least one dimension not less than 5mm
3. It satisfies the test requirements of 173.469, special form encapsulation design (high temperature, impact, percussion & leakage)
4. Must be certified: Special Form – Certificate of Competent Authority 173.476

"Special Form" Radioactive Material

Neutron Source



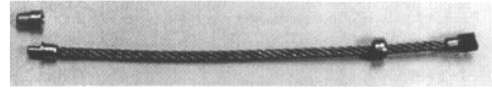
"Special Form" Radioactive Material

Density/transmission source



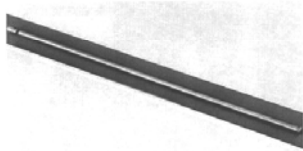
Figure B-Density/Transmission Source

"Special Form" Radioactive Materials



Industrial Radiography Source

"Special Form" Radioactive Materials

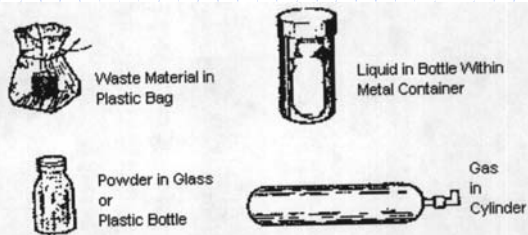


Sterilizer/Process Irradiator Source

Normal Form Radioactive Material

Class 7 (radioactive) material which has not been demonstrated to qualify as "special form Class 7 (radioactive) material"

NORMAL FORM RADIOACTIVE MATERIALS



Normal Form Materials may be solid, liquid, or gaseous and include any material which has not been qualified as Special Form

"A" Values

• **A₁** The maximum activity of special form Class 7 (radioactive) material permitted in a Type A package.

• **A₂** The maximum activity of Class 7 (radioactive) material, other than special form, LSA or SCO, permitted in a Type A package. These values are either listed in 173.435 or derived in accordance with the procedure prescribed in 173.433. (pages 48 to 53 of narrative) O8

• Be careful when using the Curie values in 173.425 for these have been rounded and not truncated. You may inadvertently exceed the Becquerel activity limits which are the governing values.

"A" Values for Selected Nuclides

	Exempt (uCi)	A1(Ci)	A2(Ci)	LQ1(mCi)	LQ2(mCi)	RQ(Ci)
◆ Tc-99m	270	270	110	270	11(liq)	100
◆ Cs-137	.27	54	16	54	16	1
◆ I-131	27	81	19	81	19	.01
◆ Co-60	2.7	11	11	11	11	10
◆ Co-57	27	270	270	27	27	100
◆ Tl-201	27	270	110	270	11(liq)	1000
◆ F-18	27	27	16	27	1.6(liq)	1000

Q9

Low Specific Activity Material (LSA)

Low Specific Activity (LSA) Material – Class 7 (radioactive) material with limited specific activity which satisfies the descriptions and limits set forth below. Shielding materials surrounding the LSA material may not be considered in determining the estimated average specific activity of the package contents. LSA material must be in one of three groups: LSA I, LSA II, or LSA III

Transport Index

The dimensionless number (rounded up to the next tenth) placed on the label of a package to designate the degree of control to be exercised by the carrier during transportation

For non-fissile packages, this value is the maximum radiation level in millirem measured one meter from the external surface of the package

Q10

Shipment Type Depends on (LQ and Type A):

- Activity of Radioactive Material
- Exposure Rate at Surface of Package
- Exposure Rate at One Meter
- Chemical and Physical Form of Material

4. Preparing a Limited Quantity / Excepted Package Shipment

Limited Quantity Shipment

- ◆ Packages containing material within the quantity limits listed on the following chart are *excepted* from specification packaging, marking, labeling and shipping paper requirements.
- ◆ However, they are not *exempt* from regulation during transportation as would materials meeting the definition of Radioactive Materials (table in 173.436)

**TABLE 8
ACTIVITY LIMITS FOR EXCEPTED PACKAGES**

Nature of contents	Instruments and articles		Materials package limits ¹
	Limits for each instrument or article ²	Package Limits ²	
Solids:			
Special form	$10^4 A_1$	A_1	$10^4 A_1$
Normal form	$10^3 A_2$	A_2	$10^3 A_2$
Liquids:			
Tritiated water:			
<0.0037 TBq/liter (0.1 Ci/L)			37 TBq (1,000 Ci)
0.0037 TBq to 0.037 TBq/L (0.1 Ci to 1.0 Ci/L)			3.7 TBq (100 Ci)
<0.037 TBq/L (1.0 Ci/L)			0.037 TBq (1.0 Ci)
Other Liquids	$10^3 A_2$	$10^3 A_2$	$10^3 A_2$
Gases:			
Tritium ³	$2 \times 10^3 A_2$	$2 \times 10^3 A_2$	$2 \times 10^3 A_2$
Special form	$10^3 A_2$	$10^3 A_2$	$10^3 A_2$
Other form	$10^3 A_2$	$10^3 A_2$	$10^3 A_2$

¹ For mixtures of radionuclides see §173.433(d).
² These values also apply to tritium in activated luminous paint and tritium absorbed on solid carriers.

See Table I in back of section

- ## Limited Quantity Shipment
1. Start by identifying the isotope and activity of material to be shipped.
 2. Determine whether material is Special Form (A_1) or Normal Form (A_2), and look up corresponding value on "Type A Quantity Package Limits Chart"
 3. Plug this Value into the "Activity Limits for Limited Quantities, Instruments, and Articles" Chart (173.425 table 7)
 4. If the activity that is to be shipped is below this number, and **ALL** of the following requirements are met, the shipment can be considered a Limited Quantity

- ## Excepted Package Requirements
- ◆ Package must meet General Design Requirements of 49 CFR 173.24 (all hazmat packages), 173.410 (Class 7)
 - ◆ Non-fixed contamination limits on package surfaces must not exceed 2200 dpm/100 cm² (minimum 300 cm² wipe) (220 dpm/100cm² for alpha emitting nuclides)
 - ◆ The outside of the inner packaging, or if there is no inner packaging, the outside of the package itself must bear the marking "RADIOACTIVE", except for instruments or article, or empty packaging

- ## Excepted package requirements cont...
- ◆ Radiation levels on package surface must not exceed 0.5 mRem per hour (173.421(a)(2))
 - ◆ For instruments or articles, the radiation level at four inches from any point on the surface of the unpackaged instrument or article may not exceed 10 mrem/hour
 - ◆ The outside of the box must be marked with the 4 digit UN number (172.101)
- Q11

What if I meet all but one of the requirements?

Sorry, your package will need to be shipped as a Type A Quantity Package, which is subject to more stringent packaging and labeling requirements, and of course...MORE PAPERWORK.

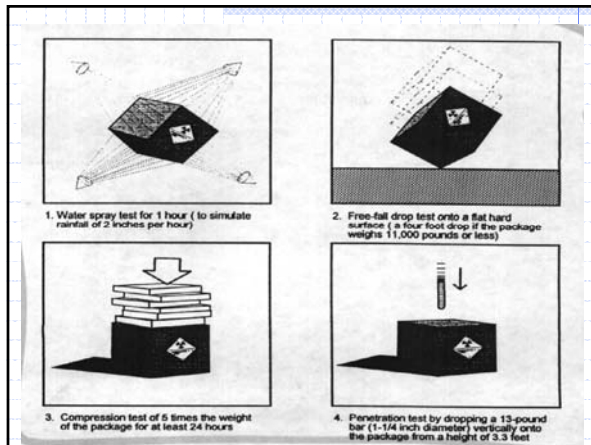
5. Preparing a Type A Quantity Shipment of Radioactive Material

Type "A" Quantity Shipment

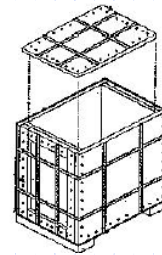
- ◆ A Type A Quantity Shipment contains radioactive material which does not exceed the A_1 (special form) or A_2 (normal form) activity limits (new!!)
- ◆ If these limits are exceeded the package will need to be shipped in a Type B package

Type A Quantity Shipment

- ◆ Type A package performance requirements and tests shall prevent loss or dispersal of contents and significant increase in the radiation levels if subject to normal conditions of transport including rough handling.
- ◆ The following tests must be performed and documented for each container type used. Certification that specifications have been met must be kept on file for at least 1 year after the latest shipment for inspection purposes.



Typical Type A Packaging Configurations



Wooden Box

Typical Type A Packaging Configurations



Steel Drum

Typical Type A Packaging Configurations



Nuclear Pharmacy Unit Dose(s) Package

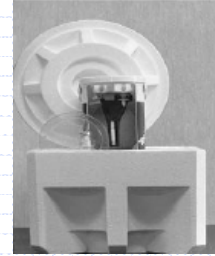
Typical Type A Packaging Configurations

Moisture
Density
Gauge &
Carrying
Case

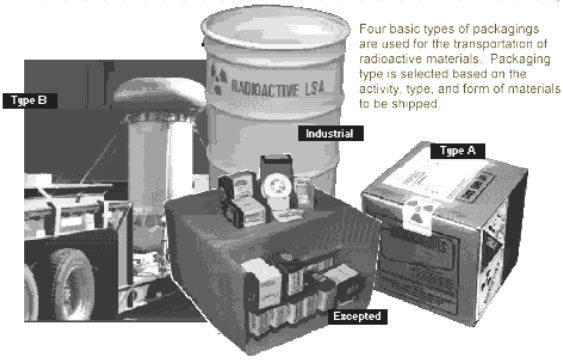


Typical Type A Packaging Configurations

Molybdenum 99
Generator

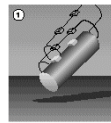


Q12

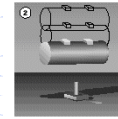


Four basic types of packagings are used for the transportation of radioactive materials. Packaging type is selected based on the activity, type, and form of materials to be shipped.

Type B Tests (conducted in sequence):

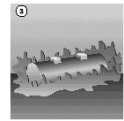


Impact test by a 9-meter (30-foot) drop onto a flat, unyielding* surface so that the package's weakest point is struck.



Puncture test by performing a 1-meter (40-inch) free drop onto a 15-centimeter (6-inch) diameter steel rod at least 20 centimeters (8 inches) long, striking the package at its most vulnerable spot.

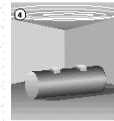
For some low-density, light-weight packages, a dynamic crush test is required, consisting of dropping a 500-kilogram (1,100-pound) mass from 9 meters (30 feet) onto the package resting on an unyielding target.



30 minutes

Heat test by exposure of the ent package to 600°C (1,475°F) for minutes.

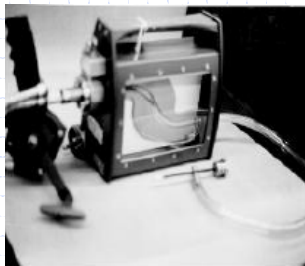
- * Using an unyielding surface ensures that any impact will be absorbed by the package rather than the surface.
- ** The water immersion test is conducted on a separate, undamaged container.



Immersion of the package under 15 meters (50 feet) of water.**

For fissile materials, packages are also immersed under 0.9 meters (3 feet) of water for at least 8 hours.

Type B Package



TYPE C packages

- ◆ US did not adopt these packages as authorized in the HMR

Type A Package – Container Marking Requirements

1. Shipping Name and UN Numbers are durably marked on the package. "Radioactive Material, Type A Package, Special Form UN 3332"
2. If greater than 110 lbs, the gross weight must be marked on outside of package
3. Must be marked "Type A" and "Radioactive Material"
4. Name and Address of Shipper and Destination
5. If overpack is used, mark "Inner Packages Meet Prescribed Specifications"
6. Letters "RQ" must be on package if limits in 172.101 Appendix A are exceeded (see Table II on page 42 in back)

Type A Package – Container Labeling Requirements

1. Two Yellow or White Radioactive Labels with the name, class, activity, and Transport Index (detailed later) Note: Activity must be listed in Bq not Ci
2. Two "Cargo Aircraft Only" labels, one label next to each of the "radioactive" labels (**unless for medical or research use**) per 173.448(f)

Type A Package – Container Labeling Requirements

- ◆ International Vehicle Registration Code of the country of origin of the design "USA"
- ◆ Air Eligibility (173.321)
 - Closures, compatibility, pressure difference, absorbent material

Radioactive Package Labels

- ◆ White I, Yellow II, Yellow III Labels
- ◆ Which label??
 - The label depends on:
 - Radiation level at surface of package
 - Radiation level at 1 meter (T.I) Q13

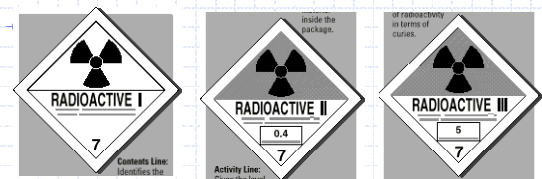
Type A Package – Selecting the Proper "Radioactive" Label Q14,15

TABLE 14
LABEL CATEGORY BASED ON TI AND SURFACE RADIATION LEVEL

Transport Index	Maximum radiation Level at any point on the external surface	Label Category ¹
0 ²	Not more than 0.005 mSv/h (0.5 mrem/h)	White – I
More than 0 but not more than 1	More than 0.005 mSv/h (0.5 mrem/h) but not more than 0.5 mSv/h (50 mrem/h)	Yellow – II
More than 1 but not more than 10	More than 0.5 mSv/h (50 mrem/h) but not more than 2 mSv/h (200 mrem/h)	Yellow – III
More than 10	More than 2 mSv/h (200 mrem/h) but not more than 10 mSv/h (1,000 mrem/h)	Yellow – III (Must be shipped under exclusive use provisions; see §173.441(b).)

Any package containing a "highway route controlled quantity" (§173.403) must be labeled as RADIOACTIVE YELLOW - III. ²If the measured TI is not greater than 0.05, the value may be considered to be zero.

Marking, Labeling and Placarding



- **Content Line:** Identifies the material inside the package
- **Activity Line:** Gives the level of radioactivity in terms of Becquerel.
- **Transportation Index (TI) Box (on Yellow II and III labels only):** Provides information used to determine the total number of packages that can be shipped together. The TI is most often determined by measuring the maximum radiation level at one meter from the surface.

Type A Shipment – Additional Requirements

- ◆ It is the responsibility of the shipper to ensure that the recipient is licensed to receive the material. A copy of the recipients license must be on file prior to shipment
- ◆ Check additional packing requirements prior to shipping liquids (e.g., must have sufficient absorbent material to prevent leaks of twice liquid volume)
- ◆ A security seal must be applied to every type A container to show the recipient that no one has tampered with the contents during shipment. Use a wire seal, a padlock is not acceptable

Type A Shipment – Additional Requirements

- ◆ No vehicle may transport more than a total of 50 TI (sum of individual package transport indexes)
- ◆ Trucks must be placarded for all Yellow III shipments; placards are not required for White I and Yellow II shipments
- ◆ A contamination survey must be performed prior to shipment. Package must have removable contamination less than 2200 dpm/100cm² (gamma emitters, 220 dpm/100cm² alpha emitters). Must wipe 300 cm².

Type A Shipment – Additional Requirements

- ◆ Dose rate should be less than **2 mRem/hr** in any position normally occupied by people during transport Q16
- ◆ Packages should be properly blocked and braced so they cannot change position Q17
- ◆ Labeled packages (White, Yellow-II, Yellow-III) cannot be carried in compartments occupied by passengers (except couriers)
- ◆ Shipping documents kept within arm's reach with seat belt fastened Q18

(Page 53 of narrative) Q19

APPENDIX D

STRAIGHT BILL OF LADING

Appendix F
Carrier No. _____
Date _____

From: **ENY SERVICE, INC.**
Chicago, Illinois 60611

To: **ENY SERVICE, INC.**
Liberty Place
Milwaukee, Wisconsin 53023

PKGS.	DESCRIPTION	CLASSIFICATION	NET WT.	GROSS WT.	HAZ. CLASS.	PLACARD	REMARKS
1	Radioactive Material, special form, M.M.S. 7 UN 2974 S.S. 604 (I.S. C1) Co-137	7			7 (I.S. C1)		
	RADIOACTIVE - YELLOW II						
	TI - 0.8 **						
	EMERGENCY RESPONSE TELEPHONE NO.: 1-800-000-0000 24 hr/7d**						
	** SUBSTITUTE APPROPRIATE INFORMATION FOR YOUR CARRIER AND SHIPMENT						

PLACARDS TENDERED: YES [] NO []

SHIPPER'S CERTIFICATE OF ACCEPTANCE FOR DANGEROUS GOODS

DATE: _____ TIME: _____

SHIPPER: _____ ADDRESS: _____ PHONE: _____

RECEIVED BY: _____ ADDRESS: _____ PHONE: _____

DATE: _____ TIME: _____

Shipping Papers

- ◆ If using FedEx please see "FedEx Dangerous Goods Acceptance Checklist"
- ◆ Supplemental information in Appendix D
- ◆ Don't forget to include Emergency Response instructions
- ◆ See example Page 54-58

Emergency Response Information

- ◆ In addition to a 24-hour Emergency Response phone number listed on the shipping paper, the information listed in Appendix E must be included separately
- ◆ See example Page 54-58

Passenger Aircraft

- ◆ 3 mRem at 1 meter (vs. normal 10 mRem TI for cargo aircraft)
- ◆ Must be for research or medical use (49 CFR 173.448(f))
- ◆ No Type B packages
- ◆ Must be on floor of cargo compartment
- ◆ Separation distances – see Appendix G, Page 31
- ◆ Shipper's Declaration of Dangerous Goods
- ◆ Shipper must have instructions (e.g., Bill of Lading and Emergency Response Information)

US Postal Service

- ◆ No Labeled Packages (White I, Yellow II and Yellow III)
- ◆ Limited Quantity Shipments or Less only
- ◆ Restrictions and Requirements same as Limited Quantity Shipments
- ◆ Except – Limits are 1/10th of those listed in 173.425 Table 7 (Activity Limits for Limited Quantities, Instruments and Articles)
- ◆ If activity over 1/10th of limits – use UPS or FedEx

FedEx Shipments

- ◆ UPS will not ship labeled packages; must use FedEx instead
- ◆ Cannot be shipped in FedEx packaging
- ◆ A Shipper's Declaration for Dangerous Goods must be completed and attached to shipment
- ◆ Markings, Labels, and Packaging requirements are the same as described earlier
- ◆ 1-800-go-fedex, extension #81

Hazmat Security Awareness Training



Hazmat Security Awareness Training (cont.)

- ◆ Completion of the Security Awareness training module *WILL* satisfy the 49 CFR, 172.704 hazmat training requirement for security awareness.
- ◆ Access Hazmat Transportation Security Awareness Training Module at:
http://www.phmsa.dot.gov/staticfiles/PHMSA/Hazmat/digipak/training_module.html
- ◆ Click on upper right corner photo for installation of Hazmat training module.
- ◆ If this is initial training, you must view the training module and answer the associated True/False questions.
- ◆ If this is refresher training, we will review the Security Awareness section in the following slides.

Security Awareness Training Review

- ◆ There are many materials that are classified as hazardous materials that can be used as deadly weapons in the hands of a terrorist.
- ◆ Hazardous materials are most vulnerable when in transit.
- ◆ You should not discuss the contents of your load or its destination with strangers along your transportation route.
- ◆ Some hazardous materials can cause a powerful explosion if ignited.
- ◆ An easy way to increase the security of hazardous materials while in transit is to lock all doors for the transport vehicle.

Security Awareness Training Review (cont.)

- ◆ The most likely terrorist threats are external threats.
- ◆ A driver's license, passport, and other types of identification can easily be forged with the use of a scanner or a color printer.
- ◆ All terrorists do not fit a preconceived picture of a criminal.
- ◆ A careful employee background check is an effective deterrent to the insider terrorist threat.
- ◆ If you are questioned about your hazardous materials transportation, it is important to know if the person asking has the need to know.

Questions

DOT Regulations

