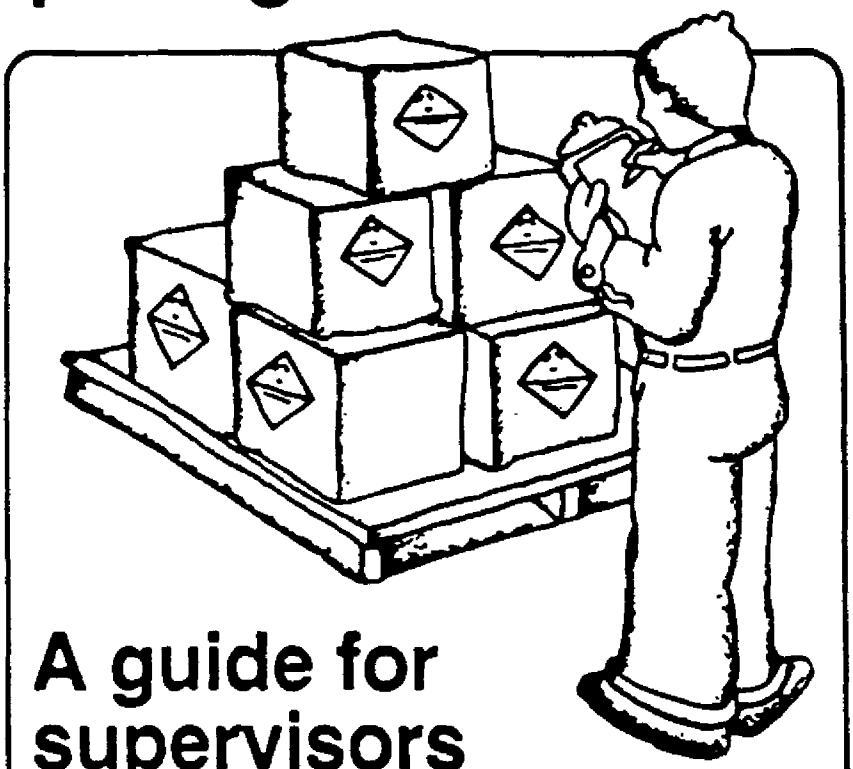
All about Radioactive materials packages



A guide for supervisors at cargo terminals

U.S. Department of Transportation

Research and Special Programs Administration

EMERGENCY TELEPHONE NUMBERS

LOCAL ASSISTANCE_____

STATE_____ _____FEDERAL_____

Company Management_____

PREFACE

This booklet was prepared for supervisors at cargo terminals where packages of radioactive materials are handled. It provides basic information on how to handle radioactive materials packages properly and how to prevent unnecessary radiation exposure of cargo handlers during the normal course of their work. In addition, this booklet discusses what to do in case of an accident.

The booklet is not an official interpretation or restatement of the regulations. Cargo supervisors should be familiar with the Department of Transportation's Hazardous Materials Regulations in the Code of Federal Regulations, Title 49, Parts 100-199.

A companion booklet, How to Handle Radioactive Materials - A Guide for Cargo Handlers, was prepared for distribution to cargo handlers. It presents basic rules for avoiding unnecessary radiation exposure and the steps to take in case of an accident. It also contains answers to some questions about radioactive materials packages that are frequently asked by cargo handlers.

Studies show that cargo handlers are currently receiving very little exposure from radioactive materials shipments. The additional exposures of most cargo handlers attributable to handling radioactive materials packages are, in fact, well below the limits recommended for individual members of the public by international and national radiation protection organizations.

However, exposures to any potentially hazardous sources should be kept as far below allowable limits as reasonably achievable. Cargo handlers should therefore follow good work habits in order to avoid any unnecessary radiation exposure. They should be instructed in the basic concepts and handling rules presented here and summarized in the companion cargo handler's guide.

Copies of this guide may be obtained from:

U. S. Department of Transportation
Research and Special Programs Administration
Materials Transportation Bureau
Office of Operations and Enforcement
Information Services Division, DMT-11
Washington, D.C. 20590

Revised October 1981

CONTENTS

HOW ARE RADIOACTIVE MATERIALS PACKAGES IDENTIFIED?

RADIOACTIVE MATERIALS PACKAGES ARE IDENTIFIED BY ONE OF THE FOLLOWING LABELS:

RADIOACTIVE
WHITE-I Label
0.5 mrem/hr maximum
on surface

← UPPER HALF IS YELLOW →

RADIOACTIVE
YELLOW-II Label
50 mrem/hr maximum on surface;
1 mrem/hr maximum at 3 feet

RADIOACTIVE
YELLOW-III Label
200 mrem/hr maximum on surface;
10 mrem/hr maximum at 3 feet *

Government regulations require that all radioactive materials packages be labeled except those containing exempt quantities as defined in the Code of Federal Regulations, Title 49, Sections 173.391 and 173.392. Packages with a RADIOACTIVE WHITE-I label have almost no radiation outside the package; packages with a RADIOACTIVE YELLOW-II label have low radiation levels; and packages with a RADIOACTIVE YELLOW-III label have higher radiation. The radiation levels allowed outside packages are limited by Federal regulations.

The information shown on a RADIOACTIVE label is as follows:

1. Contents - This line gives the name of the radioisotope. Some radioisotopes present only a slight hazard; others are considered very hazardous.
2. Number of Curies or Activity - This line tells the amount of radioactivity in terms of a unit of measure called the Curie.
3. Transport Index (TI) - This line is present only on RADIOACTIVE YELLOW-II and YELLOW-III labels. It is the number shown in the open block and indicates the highest radiation level at three feet from the surface of the package, in radiation units of millirems per hour.

WHAT IS REQUIRED OF CARRIERS THAT ACCEPT RADIOACTIVE MATERIALS PACKAGES?

The requirements for carrier handling of hazardous materials are given in the Code of Federal Regulations, Title 49, Section 174 (rail), 175 (aircraft), 176 (vessel), and 177 (public highway). Requirements of the regulations that carriers should be concerned with are to:

1. Check for the shipper's certification,
2. Check shipping papers,
3. Inspect the packages,
4. Observe loading blocking and bracing, including stowage limits and controls,
5. Placard the transport vehicle (if rail or highway) if required, and
6. Report any incidents that occur.

The following detailed information on procedures that carriers should follow is designed to help you become familiar with regulatory requirements but is not to be used in place of DOT Hazardous Materials Regulations are given in CFR, Title 49, Parts 100-199. (Future references to applicable parts of Title 49 will be noted only by the part or section number.)

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* Packages transported in a vehicle that has been consigned as *exclusive use* (except aircraft) may exceed these values.
Exclusive use means any shipment from a single consignor having the exclusive use of a transport vehicle (CFR, 49 §173.389). All initial, intermediate, and final loading and unloading must be carried out by or under the direction of the consignor, consignee, or his designated agent.

- SHIPPER'S CERTIFICATION

Do not accept radioactive materials packages without a signed certificate from the shipper indicating that 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 (§172.204). The certificate information may be stamped on the shipping papers. The certificate must be legibly signed, either manually or by typewriter or by other mechanical means.

In the case of air shipments, always keep one signed copy of the shipper's certificate with the shipment (and with each portion of the shipment if it is split). Keep a second copy on file if you are the originating air carrier.

- SHIPPING PAPERS

Check information supplied by the shipper for completeness. The information should include the proper shipping name; hazard class of Radioactive Materials if those words are not included in the proper shipping name; name of each radionuclide; physical and chemical form (if not in special form); activity in each package in terms of curies, millicuries, or microcuries; category of label; transport index (if yellow label); etc., as required by §§172.202 and 172.203 of the Regulations. If excepted from labeling, there will be no entry for the category of label applied.

Prepare the appropriate shipping papers to accompany the shipment. If specification of separation distances on shipping papers is required by the carrier, note the distances on the papers. If a shipment by air is to be split in transit, a complete set of documents must accompany each portion. For motor vehicle shipments, be sure the papers are within the immediate reach of the driver.

- PACKAGES

Inspect the packages and make sure that their security seals are intact and that they have no dents, holes, leakage, or other indication that their integrity has been compromised.

Check the labels on the packages to ensure that:
1. Labels agree with shipping papers,
2. Packages are labeled on two opposite sides,
3. The outside is marked with the appropriate specification number [§173.24(c)(1)(i)] with the proper shipping name (§172.300), and with the words TYPE A or TYPE B when applicable (§172.310).
4. Packages that are not permitted aboard passenger-carrying aircraft are labeled CARGO AIRCRAFT ONLY (§172.448).

- STOWAGE LIMITS AND CONTROLS

Do not place packages with a total transport index (TI; see page 7 for an explanation) greater than 50 in a single transport vehicle or storage location. (Note: No package offered for common transport may have a transport index exceeding 10.)

Ensure that yellow labeled packages are kept separate from areas continuously occupied by persons, live animals, and undeveloped film shipments in accordance with a table of storage time versus the total transport index (as required by §§174.700, 175.701-703, 176.700 and 177.842 of the Regulations.

Observe the prohibitions on loading, transporting, or stowing different kinds of hazardous materials together (see §§174.81, 176.83 and 177.848).

Notify the pilot in command of the aircraft, in writing, of the type of radioactive materials, type of label, quantity and location of packages, results of the inspection of the packages, and other items required by the Regulations (§175.33). This notification is required for all packages classified as hazardous material.

Observe the special stowage rules at your terminal, such as those for passenger-carrying aircraft.

- PLACARDING

Placard any rail or highway vehicle that carries a RADIOACTIVE YELLOW-III package (§172.556). Be sure the placards are displayed on the front, rear, and each side of the transport vehicle.

- REPORTING OF INCIDENTS

Report incidents involving fire, accidents, breakage, or suspected radioactive contamination to the shipper and the Department of Transportation (see §§171.15, 171.16, 174.45, 175.45, 176.48 and 177.807). Do not place in service any vehicle, area, or equipment in which radioactive materials may have been spilled until it has been surveyed and decontaminated [see §§174.750(a), 175.700(b), 176.715 and 177.861].

● WHAT ARE THE MAIN SAFETY RULES FOR THE WORKER TO KEEP IN MIND WHEN HANDLING RADIOACTIVE MATERIALS PACKAGES UNDER NORMAL CONDITIONS?

Safety in handling radioactive materials is based on keeping radiation exposure as low as reasonably achievable.

The main methods used by workers to avoid unnecessary radiation exposure rely on two key elements: time of exposure and distance from the radiation source. These elements are called time and distance. Points to remember are:

1. TIME - The rule is: Keep contact time with packages short.
   - Do not loiter in the immediate vicinity of the packages.
   - Handle packages of radioactive material without delay when moving them from one place to another.
   - Do not carry on long conversations near packages.
   - Do not do time-consuming tasks, such as paperwork, near packages.

2. DISTANCE - The rule is: Avoid staying close to packages unnecessarily.
   - Do not place packages near lunchrooms, offices, desks, or other areas occupied by workers for extended periods.
   - When transporting packages, use a vehicle that allows the required distance between the operator and the packages. Minimum distances are listed in tables in §§174.700, 175.701-.703, 176.700 and 177.842.
   - Do not place the packages inside the cab of a tug or baggage truck. Place them in the back of the truck.
   - Use a cart in preference to a two-wheeled hand truck. Place packages away from the end that is pushed.
   - Store packages at the farthest reasonable distance from working areas.

● CAN A PERSON BECOME RADIOACTIVE FROM HANDLING PACKAGES OF RADIOACTIVE MATERIAL?

A person cannot become radioactive from the radiation coming out through the air from packages of radioactive material, just as he cannot become radioactive from exposure to radiation from the sun or from an x-ray. No radioactivity or radiation remains in the person when he is away from the package. He cannot expose other people to radiation, and he does not continue to be exposed himself after he moves away from the package. Similarly, the walls of a warehouse will not become radioactive just because packages are stored next to them.

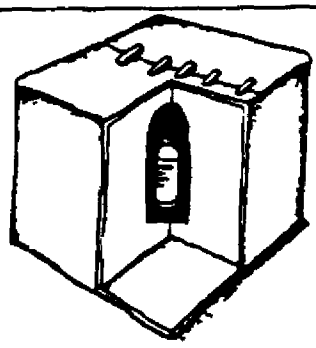
It is important to understand the difference between radiation traveling through the air, such as that coming from an intact package, and radioactive material. The *radiation* coming out of the package comes from *radioactive material* that is contained in the package. The radioactive material looks like any other material-that is, it is in the form of a solid, liquid, gas, powder, etc.

If radioactive material leaked out of a package because of an accident, it would constitute *radioactive contamination*. Unlike the radiation that it gives off, radioactive contamination is transferable. That is, it behaves like nonradioactive contamination, such as a chemical spill or dirt, in that it can be tracked, blown around, and otherwise spread and will contaminate objects or people that it reaches. It can also be cleaned up like other forms of contamination - with plenty of soap, water, and elbow grease.

Since the amount of radioactive material that leaks out of a package in case of an accident is normally too small to be seen, it must be detected with a radiation monitoring instrument. The persons doing the cleanup must be trained in the use of the monitoring instrument and in the techniques of cleanup so they will not cause the contamination to spread or to contaminate their own bodies.

● WHAT IS THE DANGER IF A PACKAGE IS BROKEN COMPLETELY OPEN?

It is easier to understand what can happen if you know how a radioactive materials package is put together. Here is what one of the most common types of packages shipped looks like:



Cutaway of a typical package of radioactive material.

At the center of the package is a small bottle containing radioactive liquid. It is surrounded by absorbent material with the capacity to absorb twice the amount of liquid in the bottle. A lead shield is placed around this material if necessary to keep down the radiation level around the package. The bottle and shield are contained in a plastic foam box to absorb any shocks and then inserted in a heavy fiberboard package.

You can see that even if the package is crushed, there is very little chance that the radioactive material will be dispersed. If radioactive material did get away, it could be breathed or swallowed. Even if some got into the body, it would not necessarily result in radiation injury. The risk of injury would depend on the kind of radioactive material and how much there was of it.

However, remember that many of the packages shipped contain radioactive drugs that are deliberately given to patients by doctors. They do not remain in the body but are eliminated in a fairly short time. The more dangerous radioactive materials are shipped infrequently and must be contained in especially strong containers. It is unlikely that the contents will leak out, even if the packages are dropped or damaged.

If leakage of radioactive material from a package is suspected, the steps described in the discussion of the next question should be followed.

WHAT STEPS SHOULD BE FOLLOWED IF THERE IS AN ACTUAL OR SUSPECTED LEAK OR ACCIDENT INVOLVING RADIOACTIVE MATERIALS PACKAGES?

Packages of radioactive materials are designed to withstand rough handling and to survive most accidents without release of the radioactive material. If radioactive material is released, quick action can reduce the consequences of the release, minimize the spread of contamination, and decrease the exposure of the workers.

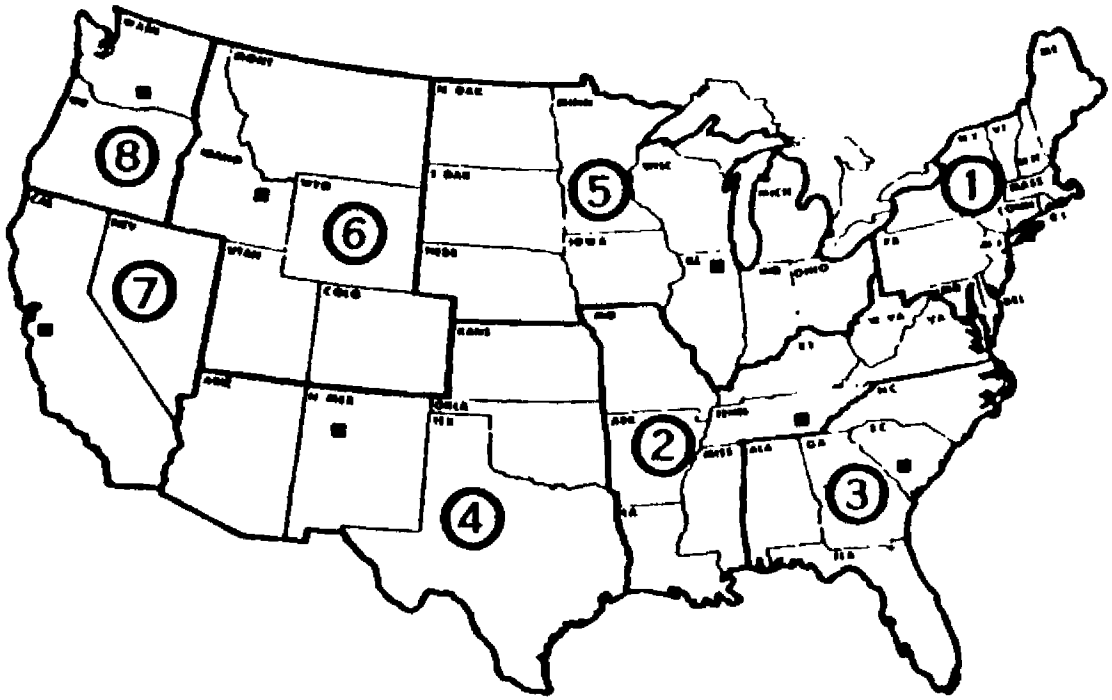
The following steps should be taken if the package is damaged or leakage is suspected:

1. Do not touch packages that show signs of leakage.
2. Isolate the package(s) by roping off at least 15 feet from the package(s), if possible, and putting up warning signs.
3. Keep people out of the area.
4. Notify designated authorities. (Make sure that you always have available a list of individuals and governmental agencies to call in case of an emergency. This list should include the shipper, State officials, the U.S. Department of Transportation, consultants, and company management. If there is a local radiation safety specialist, he may be responsible for evaluating the situation and making the necessary contacts. Assistance in the event of a transportation incident may also be obtained from the Federal Government's Interagency Radiological Assistance Plan (IRAP). Telephone numbers and geographical areas of responsibility for regional coordinating offices are shown on the next page).
5. Tell anyone who may have come in contact with the damaged package to go to a control point to be checked or advised by the radiation safety personnel.
6. Anyone who handled a potentially leaking or contaminated package should wash their hands thoroughly in a segregated lavatory as a precautionary measure. They should be checked or advised by the radiation specialist before eating, drinking, and/or smoking and before leaving the premises.
7. Do not clean up an area where an accident has occurred. This must be done under the supervision of experts and with the use of radiation monitoring instruments if significant contamination is found.

IMPORTANT NOTE: The State radiological health officials listed on the back of this booklet can provide the names of the proper persons, perhaps locally, to call for radiological advice or assistance in the event of an accident. Since telephone numbers can change, periodically check and update the State, local, Federal and other emergency numbers and write them on the front cover of this booklet <u>before</u> any accident occurs.

DEPARTMENT OF ENERGY

REGIONAL COORDINATING OFFICES FOR RADIOLOGICAL ASSISTANCE AND GEOGRAPHICAL AREAS OF RESPONSIBILITY

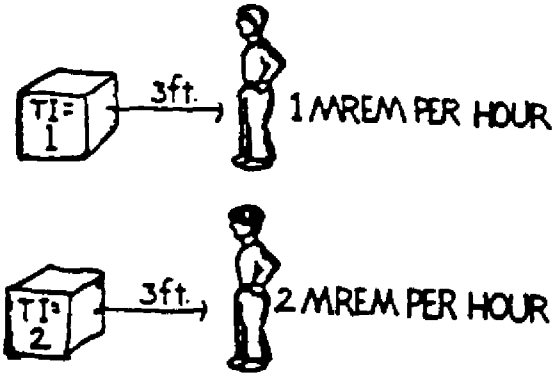


	REGIONAL COORDINATING OFFICE	POST OFFICE ADDRESS	TELEPHONE for ASSISTANCE
1	BROOKHAVEN AREA OFFICE	UPTON, L. I. NEW YORK 11973	(516) 345-2200
2	OAK RIDGE OPERATIONS OFFICE	P. O. BOX E OAK RIDGE, TENNESSEE 37830	(615) 576-1005 or (615) 626-7806
3	SAVANNAH RIVER OPERATIONS OFFICE	P. O. BOX A AIKEN, S. C. 29801	(803) 725-3333
4	ALBUQUERQUE OPERATIONS OFFICE	P. O. BOX 5400 ALBUQUERQUE, NEW MEXICO 87115	(505) 844-4667
5	CHICAGO OPERATIONS AND REGIONAL OFFICE	9800 S. CASS AVE. ARGONNE, ILLINOIS 60439	Duty Hrs. (312) 972-4800 Off Hrs. 972-6731
6	IDAHO OPERATIONS OFFICE	550 SECOND ST. IDAHO FALLS, IDAHO 83401	(208) 526-1515
7	SAN FRANCISCO OPERATIONS OFFICE	1333 BROADWAY OAKLAND CALIFORNIA 94612	(415) 273-4237
8	RICHLAND OPERATIONS OFFICE	P. O. BOX 550 RICHLAND, WASHINGTON 99352	(509) 376-7501

Revised Jan 1981

● WHAT DOES THE TRANSPORT INDEX TELL ME ABOUT THE RADIATION AROUND A PACKAGE?

The transport index, more generally referred to as the TI, is given only on RADIOACTIVE YELLOW-II and III labels. It is the highest radiation level, in *millirems per hour (mrem/hr)*, at 3 feet from any accessible external surface of the package.* That is, it tells the highest radiation dose that can be received by a person who remains for 1 hour at 3 feet from the surface of a package.



Transport Index

The regulations state that the TI of a single package cannot exceed 10 (except for packages transported in exclusive-use vehicles). For most packages, the TI is much less than 10. Common values are 3 and less.

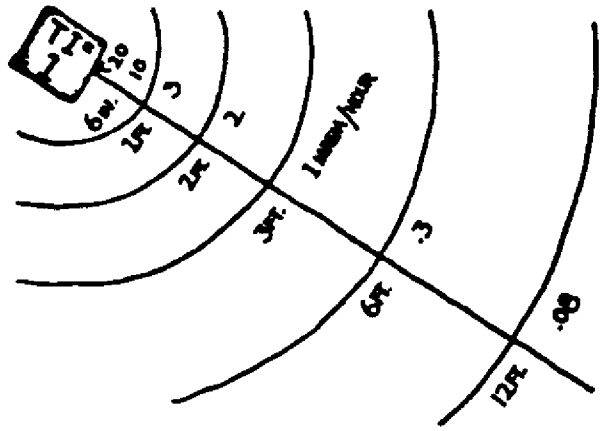
The cumulative dose at 3 feet from the surface of a package is the TI multiplied by the time (in hours). Thus, if you stayed 1 hour at a distance of 3 feet from a package with a TI of 3, the maximum dose you could get would be 3 mrem/hour x 1 hour, or 3 mrem. If you stayed half an hour, you would get half as much, or 1.5 mrem. If you stayed 2 hours, you would get twice as much, or 6 mrem.

Control of exposure to radiation is accomplished by limiting the total dose that is accumulated by a person over a period of time, usually 3 months (see section on radiation exposure).

* International carriers use 1 meter rather than 3 feet.

● HOW DOES THE RADIATION LEVEL CHANGE AT DIFFERENT DISTANCES FROM THE SURFACE OF THE PACKAGE?

The radiation level gets smaller as you get farther away from the package and larger as you get closer to the package. The diagram following shows how the radiation level changes for a 1-TI package with 15-inch sides. If you want to know about the radiation levels for a package of about the same size but with another TI, just multiply the levels in the diagram by the other TI. (The numbers are somewhat different for packages of other sizes.)



Radiation levels vs. distance from the surface of the package with TI of 1.

If you are 12 feet away from a package, the level is less than one-tenth of the level at 3 feet from the package. At this distance away, 1 foot more or less does not change the level very much. If you are 1 foot away from the package, the level is over three times the level at 3 feet. When you are close to a package, a foot or two makes a big difference in the radiation level. This fact is the reason for the most important rule regarding handling radioactive materials packages: DO NOT STAY CLOSE TO PACKAGES UNNECESSARILY.

● WHY DOESN'T THE RADIATION LEVEL GET TOO HIGH WHEN I ACTUALLY HOLD THE PACKAGE?

The radiation level would be quite high if you actually touched the radiation source, but since the source is at the center of the package, your hands cannot get very close to it. The package is required to be large enough that the dose rate at the surface is less than 50 mrem per hour for a RADIOACTIVE YELLOW-II package and less than 200 mrem per hour for a RADIOACTIVE YELLOW-III package. The levels encountered in practice are usually much lower than the allowable limits. You will not get excessive radiation exposure from holding packages during the normal short handling times of shipments.

However, because the radiation level is much higher at the surface than a few feet away, do not hold a package any longer than necessary and do not sit on or linger against radioactive materials packages when you are not actually handling them. Contact exposure rates for a RADIOACTIVE YELLOW-III label are typically 1 mrem per minute. For this reason:

- Don't hold packages with RADIOACTIVE YELLOW labels any longer than necessary to get the job done.
- Don't loiter near packages with RADIOACTIVE YELLOW labels.

● WHY ARE MANY OF THE RADIOACTIVE MATERIALS PACKAGES SO HEAVY? DOES ALL THAT WEIGHT COME FROM THE RADIOACTIVE MATERIAL?

No. The radioactive material in most packages weighs hardly anything. The weight comes primarily from radiation shielding - material placed around a radiation source to reduce radiation exposures. The shielding is incorporated into packages by the shipper to reduce the transport index and the dose rates at the surface of the

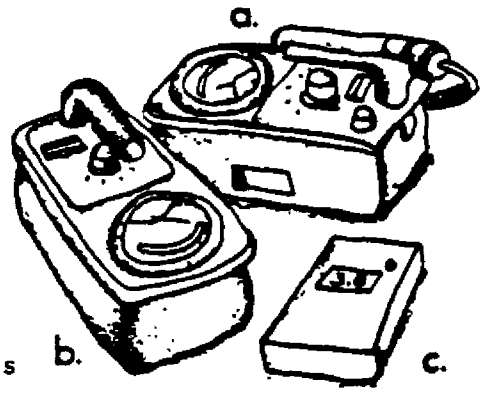
packages to below allowable levels. Heavy and thick material cuts down exposures more than light and thin material, so lead is usually used. Its thickness depends on how much the radiation has to be cut down. Some packages are quite heavy because a large amount of the lead shielding is required. The largest radiation sources shipped are so heavily shielded that they must be moved by mechanical lifting devices.

Not all radioactive materials packages are heavy. Some radioactive materials give off only weak radiation that does not require any lead shielding for protection.

● HOW CAN I DETECT THE PRESENCE OF RADIATION AND DETERMINE ITS AMOUNT?

Radiation from the packages cannot be detected by the human senses. It cannot be seen, heard, smelled or felt. However, reliable instruments are available to detect the presence of radiation.

The most commonly used instrument is the Geiger-Mueller (G-M) survey meter, or Geiger counter. It produces signals called *counts* when radiation particles cross it. The counts are indicated on a meter, which may register counts per minute or dose per hour (called the *dose rate*).



Typical G-M Survey Meters

a. Radiation measured by detector probe attached to case - needle type meter;
b. Radiation measured by detector inside case - needle type meter;
c. Radiation measured by detector inside case - digital meter.

Survey meters usually indicate the amount of radiation in *mR/hr*. This phrase refers to the accumulation of radiation exposure each hour (exposure rate) in terms of a unit called the *milliroentgen* (mR). You can take the readings in mR/hr as equal to the dose rate in *millirems per hour* (*mrem/hr*) for purposes of radiation control when you are making measurements around radioactive materials packages.*

* This statement is not true for shipment of neutron sources, but these sources are shipped very infrequently and would need to be monitored with special instrumentation that is normally not available at cargo terminals.

● HOW DO I USE A GEIGER COUNTER?

You need special training to use a Geiger counter properly. Otherwise, you could make erroneous readings with consequences that would either miss high levels or cause false alarms. The following are some general recommendations for using a counter (note, however, that you should have an instruction manual for the particular instrument you use):

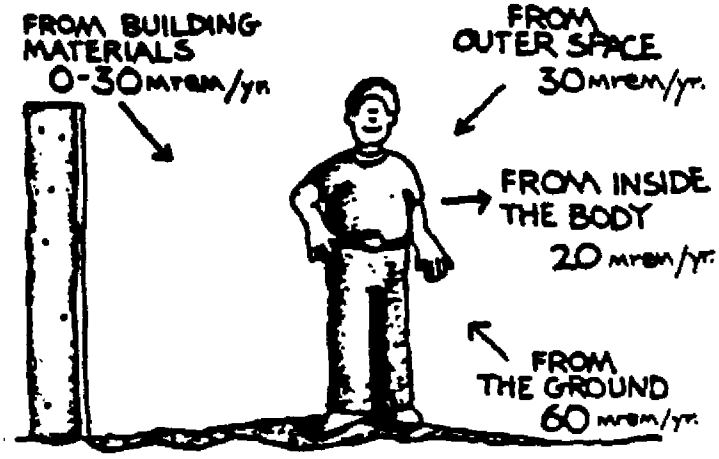
1. Look over the instrument carefully. Does it look like it may have been dropped or otherwise mistreated? Is anything broken or bent on it? If so, don't use it until it has been checked out in accordance with designated procedures.
2. Turn on the instrument. (Did the last user forget to turn it off? Then the batteries are probably dead and must be replaced.)
3. Turn to the battery check position and make sure that the batteries are good.
4. Turn the knob gently to the first reading position, and wait for a stable reading. If there is no significant reading, continue to a more sensitive position (if there is one).
5. When the instrument gives a choice of scales, use the scale that is easiest to read. For instruments with a meter movement, the needle should be between 1/4 and 3/4 of full scale for greatest accuracy.
6. Survey meters are delicate. Treat them with care. After a period of use again check the battery condition to be sure it is still good.

NOTE: THE EVALUATION OF POSSIBLE RADIATION HAZARDS INVOLVES MORE THAN JUST METER READINGS. VERY SPECIAL TRAINING IS REQUIRED, PARTICULARLY IF DAMAGED PACKAGES OR CONTAMINATION IS INVOLVED.

● IS IT TRUE THAT EVERYBODY IS CONSTANTLY EXPOSED TO RADIATION IN THE ENVIRONMENT?

Yes. Everybody in the world receives a small amount of radiation exposure at all times. Radiation is given off constantly by radioactive materials all around us - in the ground, in the walls of buildings, and even in our bodies. In addition, the earth is bombarded by radiation from the sun and from outer space, known as *cosmic radiation*. These low levels of radiation do not have any noticeable effect on the health of individuals.

The total dose to every person from naturally occurring radiation increases steadily throughout his lifetime. Every day our bodies get about a 1/4 millirem dose. This adds up to 90 millirems in a year. In 30 years, we typically receive on the order of 3000 millirems, and in a 70 year lifetime, about 7000 millirems. This dose is all from radiation in the environment. We receive another 20 millirems per year from radioactivity always present in our bodies.



Radiation exposures (in millirems) received in one year from the environment.

● IS THE AMOUNT OF RADIATION IN THE ENVIRONMENT FROM NATURAL SOURCES THE SAME EVERYWHERE?

No. There are large differences in radiation levels in different places. It all depends on how much radioactive material is in the ground at a particular location, the types of building materials, the altitude, and even the weather. The radiation in the environment has been studied in great detail with many interesting findings. Here are some typical levels you can expect at different places, given in millirems per year.

1. On a Fresh Water Lake at Sea Level: 30 Millirems per Year - Water has little natural radioactivity and serves as a radiation shield. If deep enough, it stops most of the radiation coming from the gound underneath. Almost all of the radiation exposure on the water is caused by the cosmic radiation from outer space.
2. In a Brick House at Sea Level: 120 Millirems per Year. In a Wood House at Sea Level: 90 Millirems per Year. Bricks are made from clay and other materials that contain natural radioactivity. Wood has little natural radioactivity.
3. At Ground Level at Denver, Colorado (5000 feet above sea level): 180 Millirems per Year - Cosmic radiation increases with altitude because the shielding effect of the atmosphere is equivalent to about 30 feet of water and protects us from most of the radiation from outer space. As we go up, the shielding effectiveness of the atmosphere goes down. The annual dose (from external sources) to a person living in Denver is 100 millirems greater than in Boston. A pilot flying 700 hours per year at 30,000 feet will receive 210 millirems more natural background radiation than a worker in an airport at sea level, and at 40,000 feet he will receive 420 millirems more.

● HOW MUCH RADIATION EXPOSURE DO CARGO HANDLERS ACTUALLY GET FROM HANDLING RADIOACTIVE MATERIALS PACKAGES?

The exposures received by cargo handlers from handling radioactive materials packages at busy airline terminals have been studied in some detail. The results show that cargo handlers' exposures do not differ very much from the exposures received by members of the public from natural sources. Most cargo handlers who handle radioactive materials packages receive less than 100 mrem/year as a result of their work. This amount is about the same as the additional radiation from natural sources that a person gets in Denver as compared to Boston.

In rare cases, a handler could receive as much as 500 mrem in a year if assigned to handle most of the radioactive shipments at a busy terminal. This amount is the dose limit recommended for individual members of the public from all man-made nonmedical sources of radiation. The limit for occupational exposure of radiation workers is 5000 mrem in a year. The basic guidance is to keep all doses as low as reasonably achievable.

Cargo handlers at most terminals receive only small exposures bacause of the nature of the cargo operations; that is, it is normal for packages to be processed rapidly and for contact time with the packages to be very low. All cargo handlers can reduce their doses to even lower levels if they routinely follow the Time-Distance rules of radiation protection given on page 8.

● WHERE CAN I GET ADDITIONAL INFORMATION ABOUT RADIATION AND RADIOACTIVE MATERIALS PACKAGES?

1. You may find the following publication interesting and useful. It can be obtained from the Department of Energy, Environment, Safety and Health, Washington, D.C. 20545

> *Living With Radiation* by Francis L. Brannigan
> (Publication No. ERDA 76/89)

2. The regulations pertaining to the packaging and transportation of radioactive materials are described in the following publication:

> *A Review of the Department of Transportation Regulations for Transportation of Radioactive Materials.*
> Single copies are available from the U.S. Department of Transportation, Materials Transportation Bureau, Information Services Division, Washington, D.C. 20590. Also available from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. (Stock No. 050-000-00174-1)

3. The following booklets contain information useful for first-on-the-scene responders to radioactive material transportation incidents:

> *Hazardous Materials Emergency Response Guidebook*, DOT-P-5800.2
> Available in single copies from the Department of Transportation.
>
> *Radioactive Materials Transportation Information and Incident Guidance.* Available from the Department of Transportation in 1982.

4. Other sources of information:

Government Agencies

U. S. Department of Energy
Office of Nuclear Waste Management
Mailstop B107, Germantown Building
Germantown, Maryland 20545
(301) 353-5645

U. S. Environmental Protection Agency
Office of Radiation Programs, ANR-460
401 M Street, S.W.
Washington, D.C. 20460
(202) 557-9380

U. S. Nuclear Regulatory Commission
Office of Nuclear Materials Safety and Safeguards
Washington, D.C. 20555
(202) 427-4063

Nongovernmental Organizations

Atomic Industrial Forum
7101 Wisconsin Avenue, N.W.
Washington, D.C. 20014
(202) 654-9260

League of Women Voters Education Fund
Energy Department
1730 M Street, N.W.
Washington, D.C. 20036
(202) 296-1770

Natural Resources Defense Council,Inc.
25 Kearny Street
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(415) 421-6561

STATE GOVERNMENT RADIOLOGICAL HEALTH OFFICERS as of SEPTEMBER, 1981

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Alabama	Aubrey Godwin	(205) 832-5990
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California	Joseph O. Ward	(916) 322-2073
California (Los Angeles)	Joseph Karbus	(213) 974-7891
Colorado	A. J. Hazle	(303) 320-8333
Connecticut	Arthur T. Heubner	(203) 566-5668
Delaware	Allan C. Tappent	(302) 736-4731
District of Columbia	Herbert Wood	(202) 724-4358
Florida	Ulray Clark	(904) 487-1004
Georgia	W. Scott Sprinkle	(404) 894-5144
Guam	Juan Rosario	(0) 734-9057
Hawaii	Thomas Anamizu	(808) 548-3075
Idaho	Robert Funderburg	(208) 334-4107
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Indiana	Hal Stocks	(317) 633-0150
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Kansas	Gerald W. Allen	(913) 862-9360
Kentucky	Donald R. Hughes	(502) 564-3700
Louisiana	William H. Spell	(504) 925-4518
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Massachusetts	Gerald S. Parker	(617) 727-2660
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Mississippi	Eddie S. Fuente	(601) 354-6657
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New Hampshire	John R. Stanton	(603) 271-4587
New Jersey	Eugene Fisher	(609) 292-5586
New Mexico	Thomas E. Baca	(505) 827-5271
New York	Karim Rimawi	(518) 473-3393
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New York (New York City)	Leonard Solon	(212) 566-7750
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Pennsylvania (Philadelphia)	Arthur Wallach	(215) 686-5155
Puerto Rico	David Saldana	(809) 767-3563
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