



## LESSON 2

### COLLECT AND REPORT TOTAL RADIATION DOSE INFORMATION

Critical Task: [031-503-4003](#)

#### OVERVIEW

##### LESSON DESCRIPTION:

In this lesson, you will learn about dosimeters, how they are charged, and how to collect and report a dosage reading.

##### TERMINAL LEARNING OBJECTIVE:

- ACTION:** You will collect and report total radiation dose.
- CONDITION:** You will be given information about and illustrations of radiation exposure information for tactical units and the procedure for monitoring and guiding the reading, consolidating, and reporting of radiation dosages.
- STANDARD:** You will demonstrate competency of the task skills and knowledge by responding to the multiple-choice test covering procedures required to collect and report total radiation dose.
- REFERENCES:** The material contained in this lesson was derived from [FM 3-3-1](#), [STP 3-54B2-SM](#), and TM 11-6665-214-10.

#### INTRODUCTION

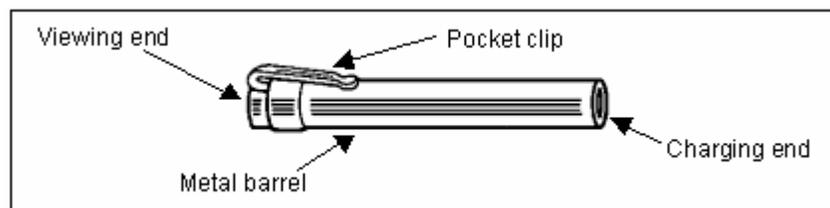
Dosimeters are radiation detection, indication, and computation (RADIAC) meters that measure the total dose of nuclear radiation (gamma rays) received by an individual. This lesson will help ensure that the total dose information is properly collected, reported, and used by the commander.

##### **PART A: IDENTIFY THE IM-93/UD, IM-93A/UD, AND IM-147/PD DOSIMETERS**

**2-1. General.** In order to understand the function of dosimeters, you must be able to describe their purpose, characteristics, principles of operation, and total-dosage range.

**2-2. Purpose.** Dosimeters are designed to measure the total dose of nuclear radiation received by an individual. Dosimeters are RADIAC meters that measure the cumulative exposure to a short duration of high-intensity gamma radiation. Gamma radiation is pure energy that travels through space in a straight line with the speed of light. Gamma radiation is invisible, and it interacts with the human body causing damage to tissues and blood-forming cells. It is these effects on the body that are of significant concern to the commander. The commander must know the total dose of nuclear radiation received by individuals in the units. This will permit the commander to more effectively employ the command on the nuclear battlefield. The main source of this nuclear radiation is fallout.

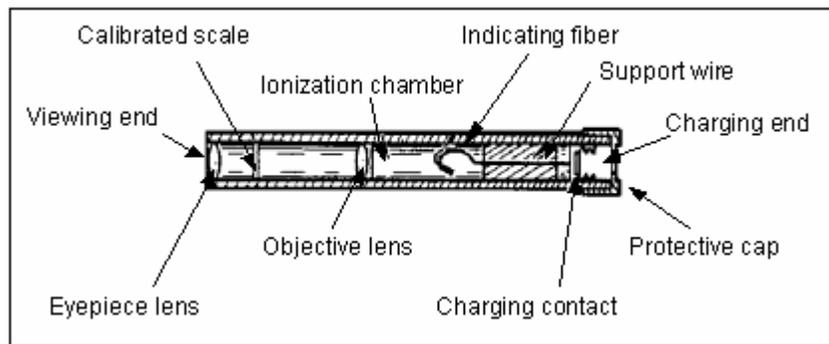
**2-3. Characteristics.** There are three models of dosimeters: IM-93/UD, IM-93A/UD, and IM 147/PD. All models are self-indicating, direct-reading pocket dosimeters. Each is a hermetically sealed assembly in a metal barrel ([Figure 2-1](#)).



**Figure 2-1. Dosimeter**

- a. IM-93/UD and IM-93A/UD dosimeters are considered standard tactical dosimeters. They are issued on the general basis of two per platoon. The readings received at this level form the basis for controlling the exposure of personnel on the nuclear battlefield.
- b. The IM-147/PD dosimeter is issued to radiological survey and monitoring teams. It permits the teams to determine when the turn-back dose has been reached. The survey and monitoring teams will receive more radiation than other soldiers who are not on the teams. The total dose for these teams is controlled. The total dose status of these teams is a matter of interest to the Nuclear, Biological, and Chemical Center (NBCC). It is one of the measures used by the NBCC in selecting which teams are to perform surveys.
- c. Features of the dosimeter are detailed below and illustrated in [Figure 2-2](#).
  - (1) Optical system. The optical system consists of an eyepiece lens and an objective lens. The eyepiece lens gives a magnified view of the calibrated scale. The objective lens gives a greatly magnified view of the shadow of the indicating fiber.
  - (2) Charging end. Light enters the dosimeter through the charging end and illuminates the field of view.
  - (3) Protective cap. A protective cap is fitted over the charging end to prevent foreign matter from entering. If the cap is made of a clear material that allows light to pass through, the dosimeter may be read with the cap on. When the cap is made of any other material, the cap must be removed to take a reading. If the protective cap is lost or defective, it should be replaced with clear cellophane tape or similar material.
  - (4) Charging contact. The charging contact allows the dosimeter to be charged using a RADIAC detector charger. This item will be referred to as a charger for the remainder of

this lesson.



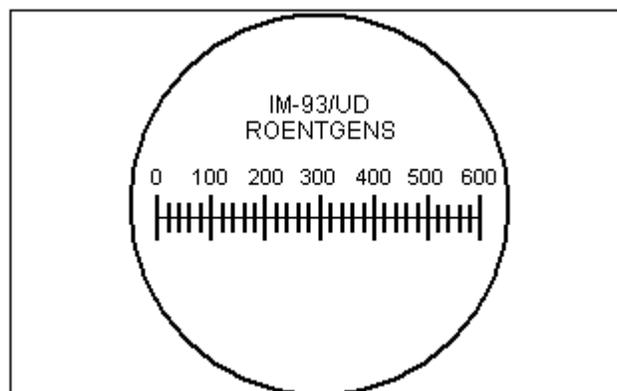
**Figure 2-2. Cross-Sectional View of the Dosimeter**

**2-4. Principles of Operation.** The conducting system in the dosimeter consists of a quartz indicating fiber and a fixed support wire. A charge placed on the conducting system causes the fiber to separate from the fixed wire element because of electrostatic repulsion. When the dosimeter is being charged, it is the charging knob on the charger that generates the static electricity. The spacing or deflection between the quartz fiber and the support wire is a function of the applied voltage generated by the charging knob. When the dosimeter is placed in a radioactive field, gamma radiation ionizes the air in the ionization chamber causing ion pairs, which cause a partial neutralization of the original charge. The indicating fiber moves toward the support wire a distance proportional to the amount of radiation to which the dosimeter has been exposed.

**NOTE: Some dosimeters may have the word RAD instead of ROENTGENS stamped on the calibration scale. The term cGy has been substituted for ROENTGENS in this subcourse.**

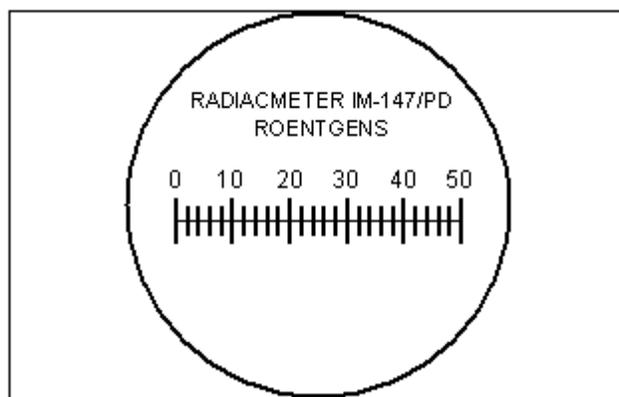
**2-5. Total-Dosage Range.**

- a. The IM-93/UD and IM-93A/UD have the same scale and will measure nuclear radiation on a scale from 0 to 600 cGy, [Figure 2-3](#).



**Figure 2-3. IM-93/UD and IM-93A/UD Calibrated Scale**

- b. The IM-147/PD dosimeter measures nuclear radiation on a scale from 0 to 50 cGy, [Figure 2-4](#).



**Figure 2-4. IM-147/PD Calibrated Scale**

c. The total-dosage range for each dosimeter is—

- IM-93/UD, 0 to 600 cGy, [Figure 2-3](#).
- IM-93A/UD, 0 to 600 cGy, [Figure 2-3](#).
- IM-147/PD, 0 to 50 cGy, [Figure 2-4](#).

## **PART B: CHARGE A DOSIMETER**

**2-6. General.** The dosimeter must be charged before it is put to use. It must also be charged whenever it becomes discharged because of leakage or exposure to radiation. The dosimeter should be charged in a dust- and radiation-free area, if possible. When the dosimeter is charged, it should not be subjected to severe shock, excessive dampness, or high temperatures.

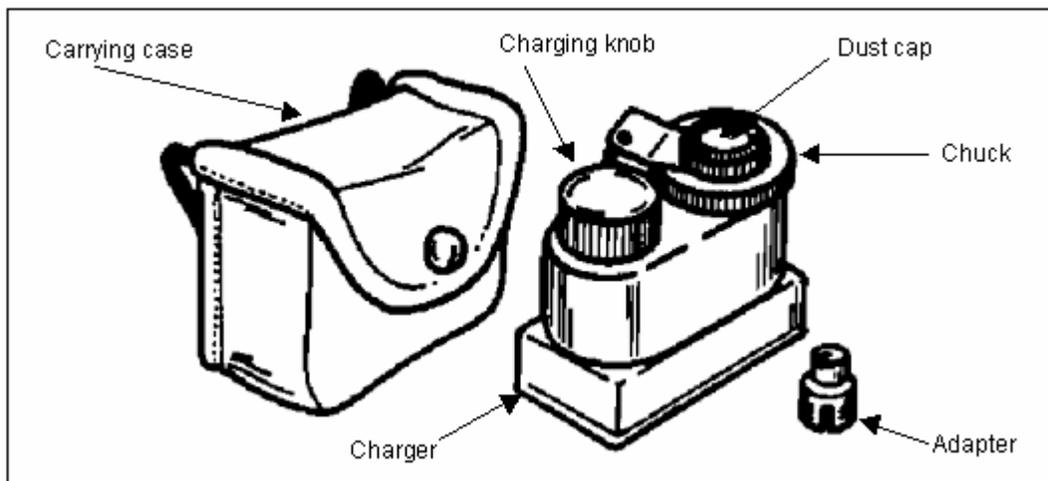
**2-7. PP-1578/PD and PP-1578A/PD Chargers.** These are two models of the RADIAC detector charger. The PP-1578A/PD charger is the newer model. The difference between the two models is the improved ease of operation of the newer model. Chargers are issued on a basis of one per four dosimeters, but no more than five or less than two per company-size unit.

a. The PP-1578/PD charger ([Figure 2-5](#)) consists of mechanical and electrical parts enclosed in a watertight metal casing. Mounted on the top of the case is a rotatable charging knob. Next to the charging knob is a charging socket with a chuck mechanism that secures the dosimeter during charging. A dust cap, secured to the case by a bead chain, protects the charging socket when the charger is not in use. An adapter, which permits the charger to be used to charge United Kingdom dosimeters, is stored in the dust cap when it is not in use.

### **CAUTION**

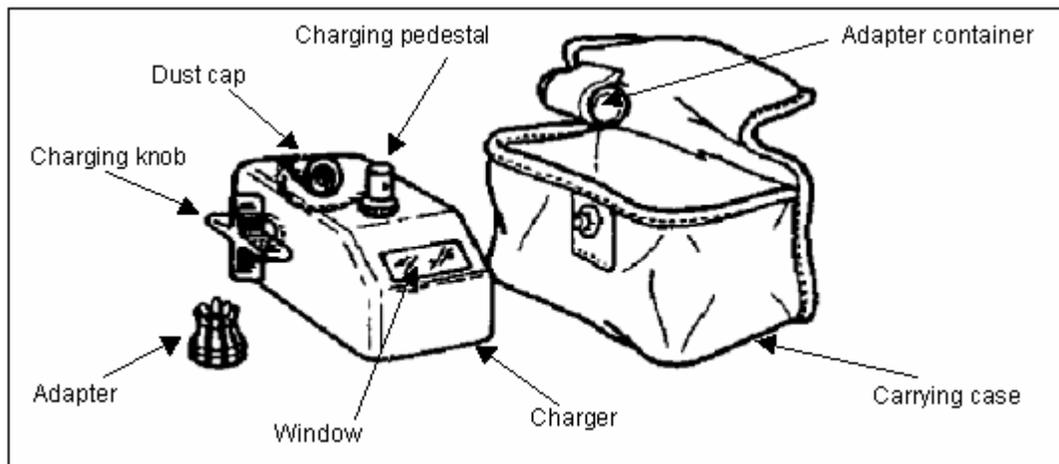
Use the adapter **ONLY** when charging United Kingdom dosimeters.

A circular glass window in the bottom of the case admits light to the bottom of the charging socket. This illuminates the calibrated scale of the dosimeter during charging. A cloth carrying case encloses the assembled charger, adapter, and dust cap. Metal hooks on the back of the carrying case permit the charger to be attached to the belt of the operator.



**Figure 2-5. PP-1578/PD RADIAC Detector Charger**

b. The PP-1578A/PD charger ([Figure 2-6](#)) is the newer model and is easier to operate. A charging pedestal is provided, instead of a charging socket. The chuck mechanism has been eliminated. The charging knob is located on the side of the case. A prismatic lens system directs light from the window to the bottom of the charging pedestal. The adapter, when not in use, is stored in a separate cylindrical container. An elastic strap secures the adapter container in the carrying case.



**Figure 2-6. PP-1578A/PD RADIAC Detector Charger**

c. A common feature of both chargers is the charging knob. Clockwise rotation of the charging knob generates a positive charge. Counterclockwise rotation of the charging knob generates a negative charge.

**2-8. Operating Instructions for the PP-1578/PD Charger.** Because of the differences between the PP-1578/PD and PP-1578A/PD chargers, the procedures for preparing and using each charger model are presented separately. Follow the procedures outlined below to operate the PP-1578/PD charger.

a. Before-operation procedures. Before the PP-1578/PD charger can be operated, the following steps must be performed:

Step 1. Remove the charger from its carrying case.

Step 2. Pull the dust cap straight out of the charging socket.

Step 3. Ensure that the charging socket is clean and dry.

**CAUTION**

The dust cap is not airtight or watertight. If water or moisture has collected or if dust, dirt, or other foreign matter has entered the charging socket, it must be cleaned and dried thoroughly before use. Otherwise, the charger will not operate properly.

Step 4. Rotate the chuck counterclockwise to its fully opened position.

Step 5. If the charger has not been used for a month or longer, turn the charging knob clockwise a minimum of ten revolutions to activate the voltage regulator.

Step 6. See that the charging end and the body of the dosimeter to be charged are thoroughly clean and dry.

b. Adapter installation procedures. If charging United Kingdom dosimeters, install the adapter using the steps outlined below.

**CAUTION**

Do not attempt to charge other types of dosimeters with the adapter installed.

Step 1. Remove the adapter from the dust cap and ensure that it is clean and dry.

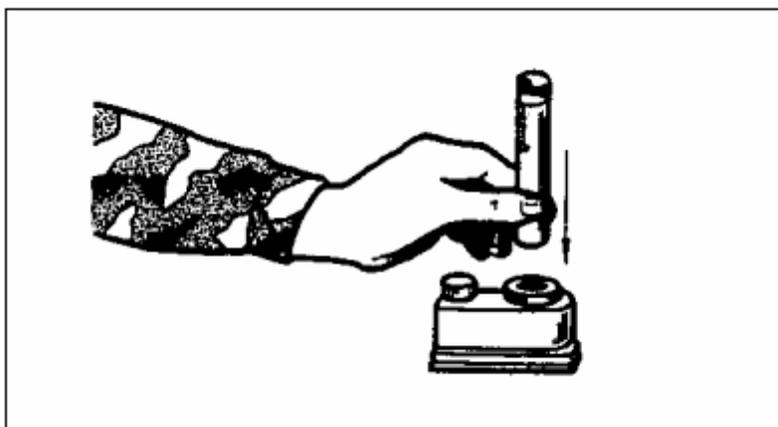
Step 2. Insert the adapter (larger end down) into the charging socket. Ensure that the adapter seats firmly in the charging socket.

c. Dosimeter charging procedures. Once the charger has been prepared, use it to charge dosimeters as follows:

Step 1. Insert the dosimeter's charging end into the charging socket as far as it will go, applying firm pressure straight downward ([Figure 2-7](#)).

**CAUTION**

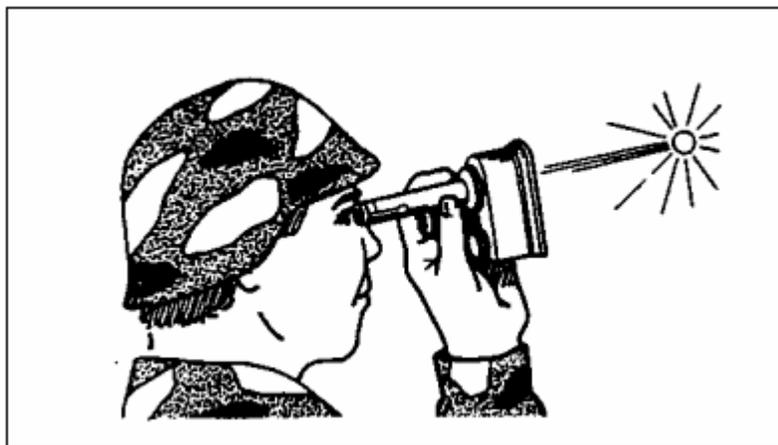
Do not apply too much pressure on the dosimeter, or the plastic disk in the dosimeter's charging end may rupture.



**Figure 2-7. Inserting the Dosimeter Into the Charging Socket**

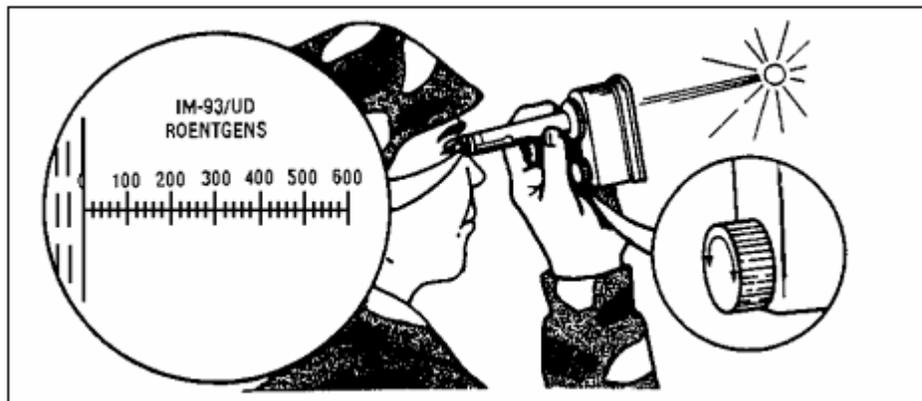
Step 2. Hold the dosimeter firmly in the charging socket. Tighten the chuck by rotating it clockwise until the dosimeter is held securely in the charging socket.

Step 3. Hold the charger (with the dosimeter installed) so that the window is pointed toward a good source of light (Figure 2-8). A flashlight is a good field expedient.



**Figure 2-8. Holding the Charger With Dosimeter to a Light Source**

Step 4. Look into the viewing end of the dosimeter and observe the calibrated scale. Turn the charging knob clockwise until the dosimeter reading is zero (indicating fiber on 0). If the indicating fiber goes to the left of zero, rotate the charging knob back and forth or turn it counterclockwise until a zero reading on the calibrated scale is obtained (Figure 2-9).



**Figure 2-9. Checking the Calibrated Scale Reading**

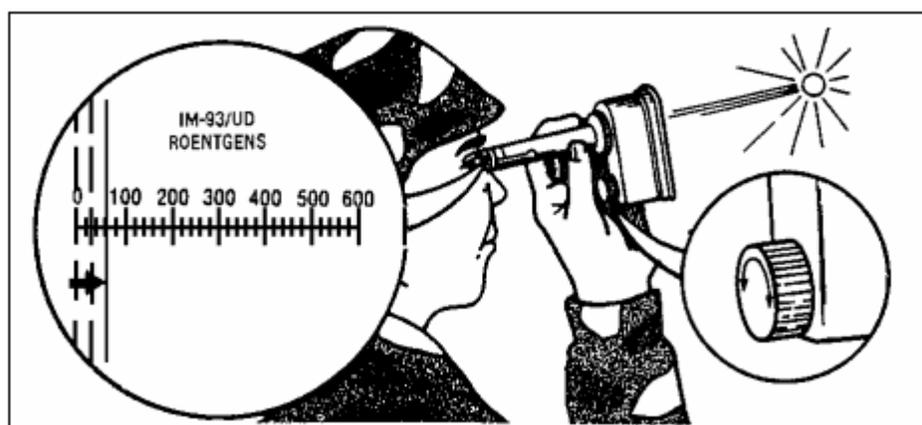
Step 5. If the indicating fiber can be seen, charge the dosimeter in the normal way. If the indicating fiber cannot be seen, proceed as follows:

(a) Rotate the charging knob clockwise five full revolutions. Then observe whether the indicating fiber can be seen. If the indicating fiber is visible, charge the dosimeter in the normal way.

(b) If the indicating fiber still cannot be seen, rotate the charging knob counterclockwise five full revolutions. Then observe whether the indicating fiber has appeared. If the indicating fiber is visible, charge the dosimeter in the normal way.

(c) If the indicating fiber still cannot be seen, rotate the charging knob counterclockwise an additional five revolutions, and again observe whether the indicating fiber has appeared. If the indicating fiber is visible, charge the dosimeter in the normal way. If the indicating fiber still cannot be seen, the dosimeter or the charger is faulty.

d. Leakage inspection procedures. Install the dosimeter on the charger and watch the indicating fiber closely. The permissible leakage discharge rate is too slow to be seen on the dosimeter's calibrated scale. If the indicating fiber can be seen to move upscale away from zero, either the dosimeter or the charger is dirty or faulty ([Figure 2-10](#)). Proceed as follows:



**Figure 2-10. Checking the Calibrated Scale Reading**

Step 1. Loosen the chuck and remove the dosimeter from the charging socket. Observe the reading on the dosimeter's calibrated scale.

Step 2. If the indicating fiber can still be seen to move, clean the charging end of the dosimeter. Then charge it again. If leakage still is evident after the second charging, the dosimeter is faulty.

Step 3. If leakage is evident when the dosimeter is installed in the charger but not when it is removed, clean the charging socket thoroughly. Then repeat the charging procedures.

Step 4. If leakage still is evident when the dosimeter is installed in the charger but not when it is removed, the charger is faulty. However, the charger can still be used if it will charge a dosimeter below zero. If leakage is evident only when the dosimeter is in the charger, proceed as follows:

(a) Install the dosimeter in the charger. Press down firmly on the dosimeter. Do not tighten the chuck.

(b) Turn the charging knob clockwise until the indicating fiber is off-scale left of zero.

(c) Watch the indicating fiber closely. Remove the dosimeter from the charger the instant the indicating fiber reaches zero on the calibrated scale.

e. Capacitive-jump-occurrence procedures. On some dosimeters, particularly low-range instruments, an instantaneous partial discharge may occur as the dosimeter is removed from the charger. This partial discharge is called a capacitive jump. After the dosimeter has been charged, loosen the chuck and remove the dosimeter from the charging socket. Then observe the reading on the calibrated scale. If the indicating fiber has jumped upscale, proceed as follows:

Step 1. Install the dosimeter in the charger. Turn the charging knob clockwise until the indicating fiber is on the downscale side of zero an amount equal to the capacitive jump.

Step 2. Remove the dosimeter from the charger and observe the reading.

Step 3. Repeat Steps 1 and 2 until a zero reading is obtained after the dosimeter has been removed from the charger. A zero reading on the dosimeter must be obtained after the dosimeter has been charged and checked.

f. After-operation procedures. After the PP-1578/PD charger has been used to charge the dosimeters, return it to its carrying case in the following manner:

Step 1. Remove the adapter, if used, from the charging socket and place it in the dust cap.

Step 2. Press the assembled adapter and dust cap into the charging socket.

Step 3. Place the assembled charger in its carrying case and fasten the flap.

**2-9. Operating Instructions for the PP-1578A/PD Charger.** Use the following procedures to correctly operate the PP-1578A/PD charger:

a. Before-operation procedures. Before the PP-1578A/PD charger can be operated, it must be prepared as follows:

Step 1. Remove the charger from its carrying case.

Step 2. Unscrew the dust cap and lift it off the charging pedestal.

Step 3. Ensure that the charging pedestal is clean and dry.

Step 4. If the charger has not been used for a month or longer, turn the charging knob clockwise a minimum of ten revolutions to activate the voltage regulator.

Step 5. Place the charger on a flat, level surface, such as a bench or table. Face the window of the charger toward a good source of light.

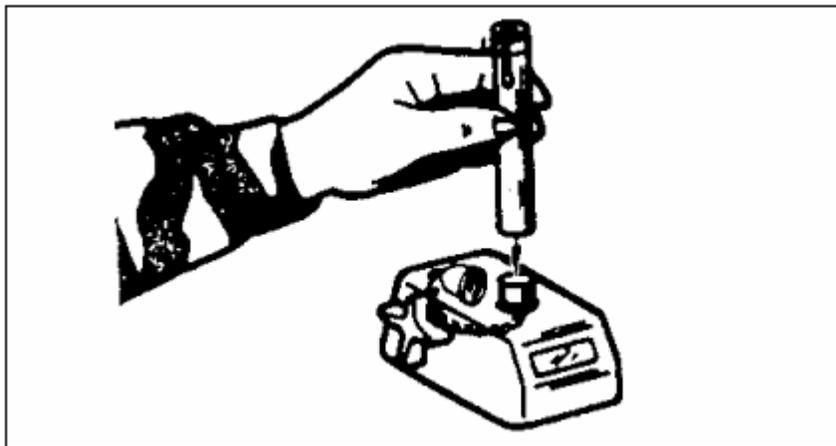
Step 6. Ensure that the charging end and the body of the dosimeter are thoroughly clean.

b. Dosimeter charging procedures. After the charger has been prepared, it is used to charge dosimeters as follows:

Step 1. Place the charging end of the dosimeter over the charging pedestal. Then, applying firm pressure, press the dosimeter straight down onto the charging pedestal ([Figure 2-11](#)).

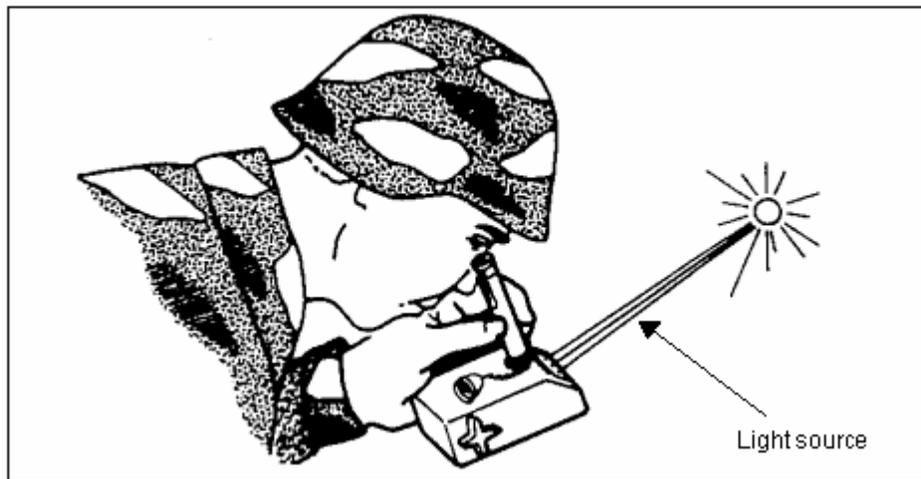
#### CAUTION

Be sure to press the dosimeter straight down. Do not apply too much pressure, or the plastic disk in the dosimeter's charging end may rupture.



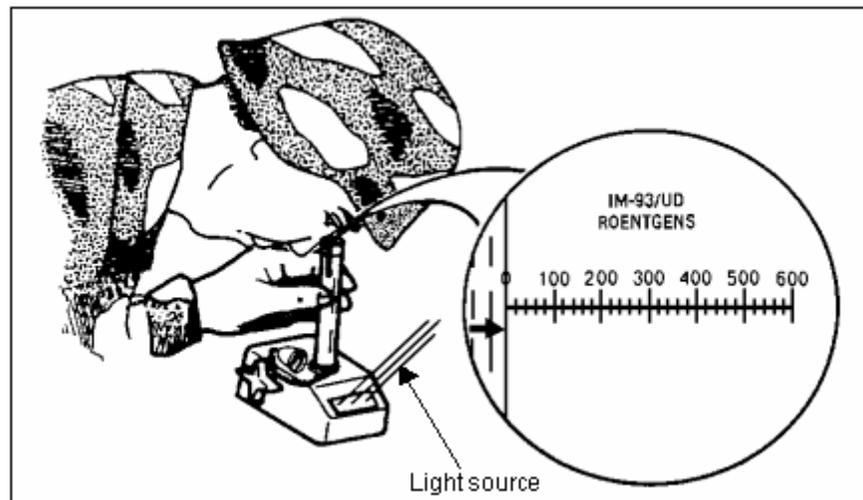
**Figure 2-11. Placing the Dosimeter Over the Charging Pedestal**

Step 2. Hold the charger with the dosimeter installed so that the window is toward a good light source ([Figure 2-12](#)). A flashlight is a good field expedient.



**Figure 2-12. Holding the Charger With Dosimeter to a Light Source**

Step 3. Watch the calibrated scale of the dosimeter. Turn the charging knob clockwise until the dosimeter reading is zero (indicating fiber on 0). If the indicating fiber goes to the left of zero, rotate the charging knob back and forth or turn it counterclockwise until a zero reading on the calibrated scale is obtained (Figure 2-13).



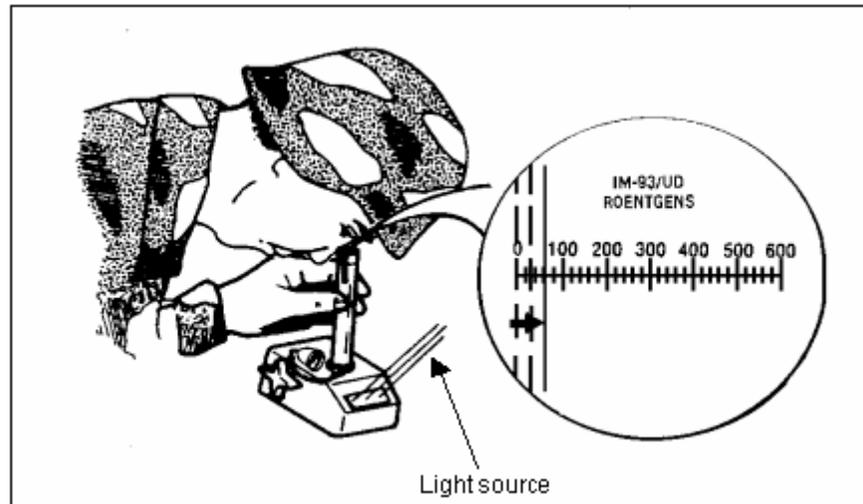
**Figure 2-13. Checking the Reading on the Calibrated Scale**

Step 4. Look into the viewing end of the dosimeter and observe the calibrated scale. If the indicating fiber can be seen, charge the dosimeter in the normal way. If the indicating fiber cannot be seen, proceed as follows:

- (a) Rotate the charging knob clockwise five full revolutions. Then observe whether the indicating fiber can be seen. If the indicating fiber is visible, charge the dosimeter in the normal way.
- (b) If the indicating fiber still cannot be seen, rotate the charging knob counterclockwise five full revolutions. Then observe whether the indicating fiber can be seen. If the indicating fiber is visible, charge the dosimeter in the normal way.

(c) If the indicating fiber still cannot be seen, rotate the charging knob counterclockwise an additional five revolutions, and again observe whether the indicating fiber has appeared. If the indicating fiber is visible, charge the dosimeter in the normal way. If the indicating fiber still cannot be seen, the dosimeter or the charger is faulty.

c. Leakage inspection procedures. Install the dosimeter on the charger and watch the indicating fiber closely. The permissible leakage discharge rate is too slow to be seen on the dosimeter's calibrated scale. If the indicating fiber can be seen to move upscale away from zero, either the dosimeter or the charger is dirty or faulty ([Figure 2-14](#)). Proceed as follows:



**Figure 2-14. Viewing the Indicating Fiber Moving Away From Zero**

Step 1. Remove the dosimeter from the charging pedestal and observe the reading on the dosimeter's calibrated scale.

Step 2. If the indicating fiber can still be seen to move, clean the charging end of the dosimeter. Then repeat the procedure. If leakage still is evident after the second charging, the dosimeter is faulty.

Step 3. If leakage is evident when the dosimeter is installed in the charger but not when it is removed, clean the charging pedestal thoroughly. Then repeat the procedures for charging the dosimeter.

Step 4. If leakage still is evident when the dosimeter is in the charger but not when it is removed, the charger is faulty. However, the charger can still be used if it will charge a dosimeter below zero. If leakage is evident only when the dosimeter is in the charger, proceed as follows:

(a) Install the dosimeter in the charger. Press down firmly on the dosimeter.

(b) Turn the charging knob clockwise until the indicating fiber is off-scale left of zero.

(c) Watch the indicating fiber closely. Remove the dosimeter from the charger the

instant the indicating fiber reaches zero on the calibrated scale.

(d) If necessary, repeat Steps 4(a) through 4(c) until a zero reading is obtained after removing the dosimeter from the charger.

d. Capacitive-jump-occurrence procedures. On some dosimeters, particularly low-range instruments, an instantaneous partial discharge may occur as the dosimeter is removed from the charger. This partial discharge is called a capacitive jump. After the dosimeter has been charged, remove the dosimeter from the charging pedestal. Then observe the reading on the calibrated scale. If the indicating fiber has jumped upscale, proceed as follows:

Step 1. Place the charging end of the dosimeter over the charging pedestal. Turn the charging knob clockwise until the indicating fiber is on the downscale side of zero an amount equal to the capacitive jump.

Step 2. Remove the dosimeter from the charger and observe the reading.

Step 3. Repeat Steps 1 and 2 until a zero reading is obtained after the dosimeter has been removed from the charger. A zero reading on the dosimeter must be obtained after the dosimeter has been charged and checked.

e. After-operation procedures. After the PP-1578A/PD charger has been used, return it to its carrying case in the following manner:

Step 1. Unscrew the adapter, if used, from the charging pedestal and place it in its container in the carrying case.

Step 2. Screw the dust cover into place over the charging pedestal.

Step 3. Place the assembled charger in its carrying case and fasten the flap.

**2-10. Dosimeter Recharging.** To prevent excessive leakage of a charge, dosimeters must be recharged after no more than two or three days of use. They must also be recharged when the total dose reaches or exceeds 500 cGy on the scale. Recharging times are normally designated in the unit's standing operating procedure (SOP).

**2-11. Procedures for Leakage Testing.** The charge that is placed on the dosimeter will gradually leak, even though the dosimeter is not exposed to radiation. This leakage, if excessive, will cause an improper reading on the dosimeter during use. The leakage should not be more than 2 percent of the full-scale reading per day for a good dosimeter. Check the leakage rate as follows:

**NOTE: If the dosimeter has not been charged for an extended period of time or has been stored in an uncharged condition and is then fully charged, excessive leakage may occur. This excessive leakage is due to insulation soak-in, penetration of part of the charge into the insulation. Do not perform a leakage-rate check on the dosimeter until it has been charged to zero for five consecutive days. Ignore the daily leakage that may occur during this period.**

Step 1. Charge the dosimeter to read zero on the calibrated scale.

Step 2. Store the dosimeter in a radiation-free area for a 24-hour period.

Step 3. Note the reading on the dosimeter's calibrated scale. This reading represents the leakage rate in cGy per day.

**NOTE: If the leakage-rate reading for a period of one day is difficult to determine, the charged dosimeter may be allowed to set for several days until a readable value can be obtained. When the reading is obtained, divide the total reading by the number of days that the charged dosimeter was allowed to set to obtain the average daily leakage rate.**

Step 4. If the leakage rate is greater than 12 cGy per day for the IM-93/UD or IM-93A/UD, or 1 cGy per day for the IM-147/PD, clean the charging end of the dosimeter.

Step 5. Recheck the leakage rate following Steps 1 through 4. If the leakage rate is still greater than the values given in Step 4, the dosimeter is defective and should be replaced. The acceptable leakage rate per day for each of the dosimeter models is—

- IM-93/UD, 12 cGy.
- IM-93A/UD, 12 cGy.
- IM-147/PD, 1 cGy.

## **PART C: REPORT RADIATION DOSAGE READINGS TAKEN WITH A DOSIMETER**

**2-12. General.** The standard tactical dosimeter, the IM-93/UD, is issued on the general basis of two per platoon. If elements of a platoon-size unit operate separately under conditions to warrant it, a wider issue of dosimeters may be made.

a. The unit assigns primary and alternate dosimeter wearers for each dosimeter. This allows the dosimeter to remain with the platoon when the primary wearer leaves the platoon area. When selecting personnel to wear the dosimeter, you should select personnel who will be doing the same tasks as most of the other soldiers. The unit dosimeter wearer uses a charged dosimeter to take during-operation readings or after suspected exposure.

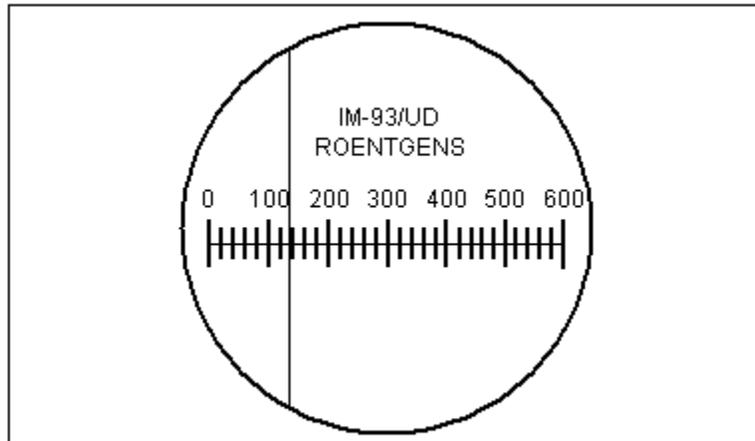
b. Use the following procedures to read the calibrated scale:

- (1) Look at a light source through the dosimeter's eyepiece lens.
- (2) Rotate the dosimeter until the calibrated scale is in the horizontal position.
- (3) Note the position of the shadow (indicating fiber) on the calibrated scale.
- (4) Determine the amount of radiation detected.

For example, if the reading on the IM-93/UD or the IM-93A/UD dosimeter's calibrated scale is 75 cGy at the first reading and 110 cGy at the second, the total radiation exposure for the period is 35 cGy.

c. When the dosimeter is read, the dosimeter wearer makes a note of the reading. The next time the dosimeter is read, the wearer again makes a note of the reading and reports only the difference

between the two readings. The readings can be jotted down in a pocket notebook and kept until the next reading. There is no requirement to keep this information as a permanent record. Dosimeters are read and the readings reported before recharging the dosimeter. The amount of radiation detected in [Figure 2-15](#) is 125 cGy.



**Figure 2-15. IM-93/UD and IM-93A/UD Calibrated Scale**

d. Tactical dosimeters will be read daily or more often if the situation dictates. The "net" readings (or the amount accumulated since the last reading) of the platoon's two dosimeters will be averaged, rounded off to the nearest 10 cGy, and reported to the company. If there is a reason to believe that the reading from one dosimeter is not representative of the platoon, it should not be used. For example, the person carrying the dosimeter may have been shielded or operating away from the platoon. In such cases, only the reading from the one representative dosimeter is used.

e. The platoon reports to the company only the net reading. The company reports the platoon readings to the Operations and Training Officer (US Army) (S3) at battalion or similar-size unit by radio or telephone daily or when the situation permits. When units are exposed to relatively high doses that exceed the established OEG, the reports should be processed without delay. The unit SOP will specify the time and method of reading and transmitting the information to the next higher headquarters.

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[Practice Exercise](#)

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