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THE ORNL POCKET METER PROGRAM: INTERNAL OPERATING PROCEDURES

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ABSTRACT

The ORNL Pocket Meter Program is designed for auditing the approximate photon radiation exposure of Oak Ridge National Laboratory (ORNL) radiation workers. Although pocket meters are considered to be a secondary personnel dosimetry system at ORNL, they are valuable indicators of unplanned exposures if proper procedures are followed for testing, calibrating, deploying, wearing, processing, and recording data.

INTRODUCTION

Pocket ionization chambers (pocket meters) are provided by the Radiation Dosimetry Group of the Environmental and Occupational Safety (EOS) Division for the purpose of auditing the approximate photon radiation exposure of radiation workers within periods of time between personnel dosimeter or badge processing. They are worn by Oak Ridge National Laboratory (ORNL) personnel while performing work or visiting

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for extended times in a radiation zone or in a combination of radiation zones.

Although pocket meters are considered to be a secondary source of personnel dosimetry system at ORNL and are used only in conjunction with an ORNL-supplied personnel dosimeter, they are valuable indicators of unplanned exposures as well as routine exposures. They are useful for establishing the need to process primary personnel dosimeters at times other than their scheduled processing date. (It is important to note that pocket meters provide unofficial numbers that are used only as a guide in assessing actual exposure. Some variance between pocket meters, visual dosimeters, and badge readings is to be expected.)

Pocket meters are in widespread use throughout the Laboratory; approximately 1200 are read each day. In order to insure confidence in results, close attention must be paid to their use and maintenance. This report contains a description of the meters and their read-out devices, as well as procedures for wearing, charging, deploying, reading, data reporting, maintenance and quality assurance. Adherence to these recommendations will result in a reliable secondary dosimetry system for ORNL radiation workers.

EQUIPMENT DESCRIPTION

POCKET METER

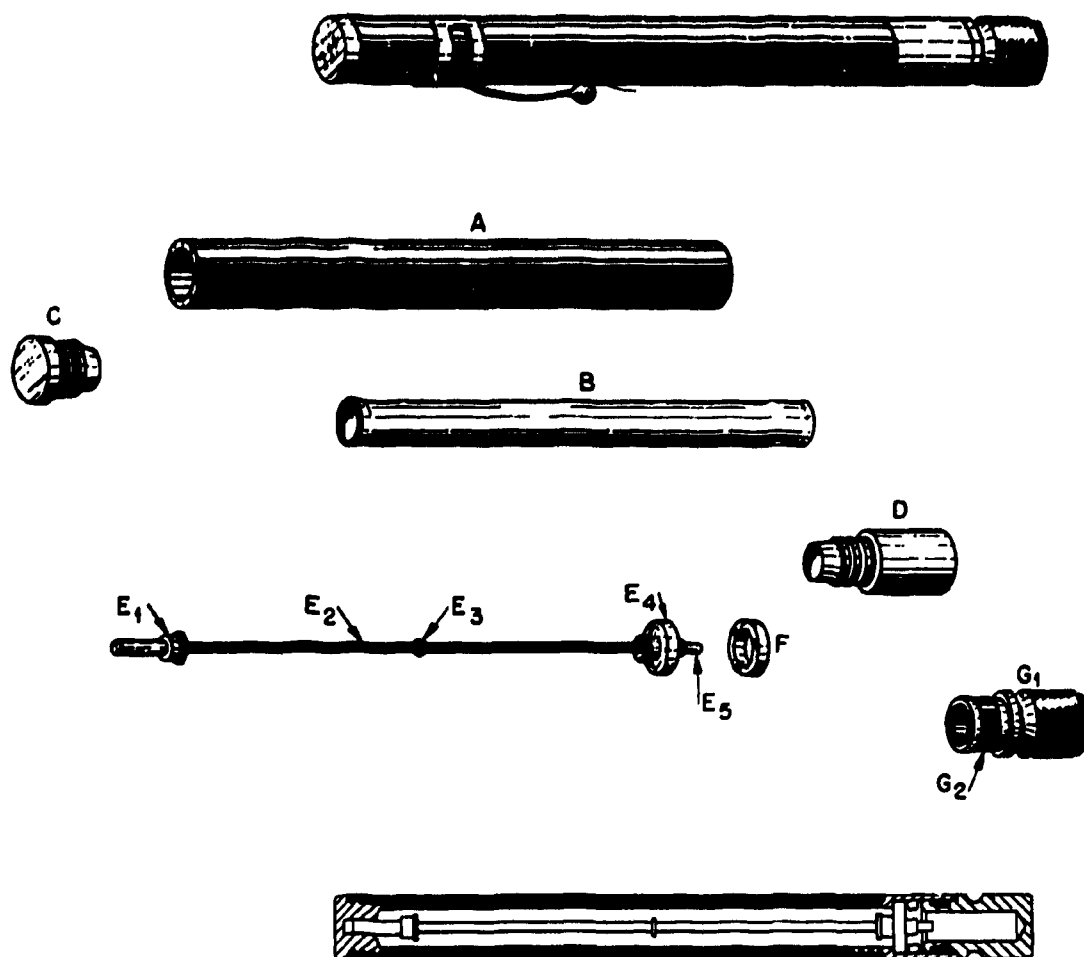
The pocket meter is an indirect-reading x- and gamma-ray photon dosimeter used to measure personnel exposures in the 10- to 200-mR range (see Fig. 1). The principal components, shown in Fig. 2, are a cylindrical outer wall, a central-rod electrode, insulators, and a protective cap.

The meters are insensitive to beta radiation of maximum energy less than 1 MeV, but will not differentiate between beta radiation

ORNL Photo 12040



Fig. 1. Pocket ionization chamber



VICTOREEN POCKET METER, MODEL 352

- | | |
|---|---|
| A. LOW ATOMIC NUMBER WALL | E ₃ POLYETHYLENE INSULATING WASHER |
| B. GRAPHITE-COATED PAPER SHELL | E ₄ POLYSTYRENE FIXED BUSHING |
| C. ALUMINUM TERMINAL HEAD | E ₅ ELECTRODE CONTACT |
| D. ALUMINUM TERMINAL SLEEVE | F. RETAINING RING |
| E ₁ POLYSTYRENE SUPPORT BUSHING | G ₁ ALUMINUM BASE CAP |
| E ₂ CENTRAL ELECTRODE, GRAPHITE COATED | G ₂ POLYETHYLENE FRICTION BUSHING |

Fig. 2. Principal components of a pocket ionization chamber

above 1 MeV and gamma or X radiation. Although their accuracy is within $\pm 10\%$ of full scale when calibrated with a radium source, their actual field response is dependent upon a variety of factors such as orientation, radiation quality, etc. Read-out is performed with a charger-reader or minometer.

CHARGER-READER

The Minometer-II is an electronic charger-reader for indirect-reading dosimeters (see Fig. 3) The unit has a transistorized printed circuit and a large mirrored panel meter which is calibrated in milliroentgens. Ranges are 0 to 40 mR and 0 to 200 mR. Accuracy is $\pm 10\%$ of full scale if proper operating procedures are followed.

PROCEDURES

USE OF POCKET METERS

Pocket meters are used by ORNL employees whose exposure to external X or gamma radiation may exceed 20 mR per day or where specified by posted entry requirements. They are made available for use in dispensing racks at or near the main pedestrian entry portals and in many work areas at ORNL.

Employees participating in the pocket meter program should take any two meters from the dispensing rack and clip them securely to the clothing near their personnel dosimeter. The meters must be protected from severe shock (such as dropping) and exposure to liquids, corrosive substances, grease, dirt, etc. The end cap should never be removed.

The pair of pocket meters are to be worn for one work shift only, including overtime. Meters should be exchanged for fresh ones when

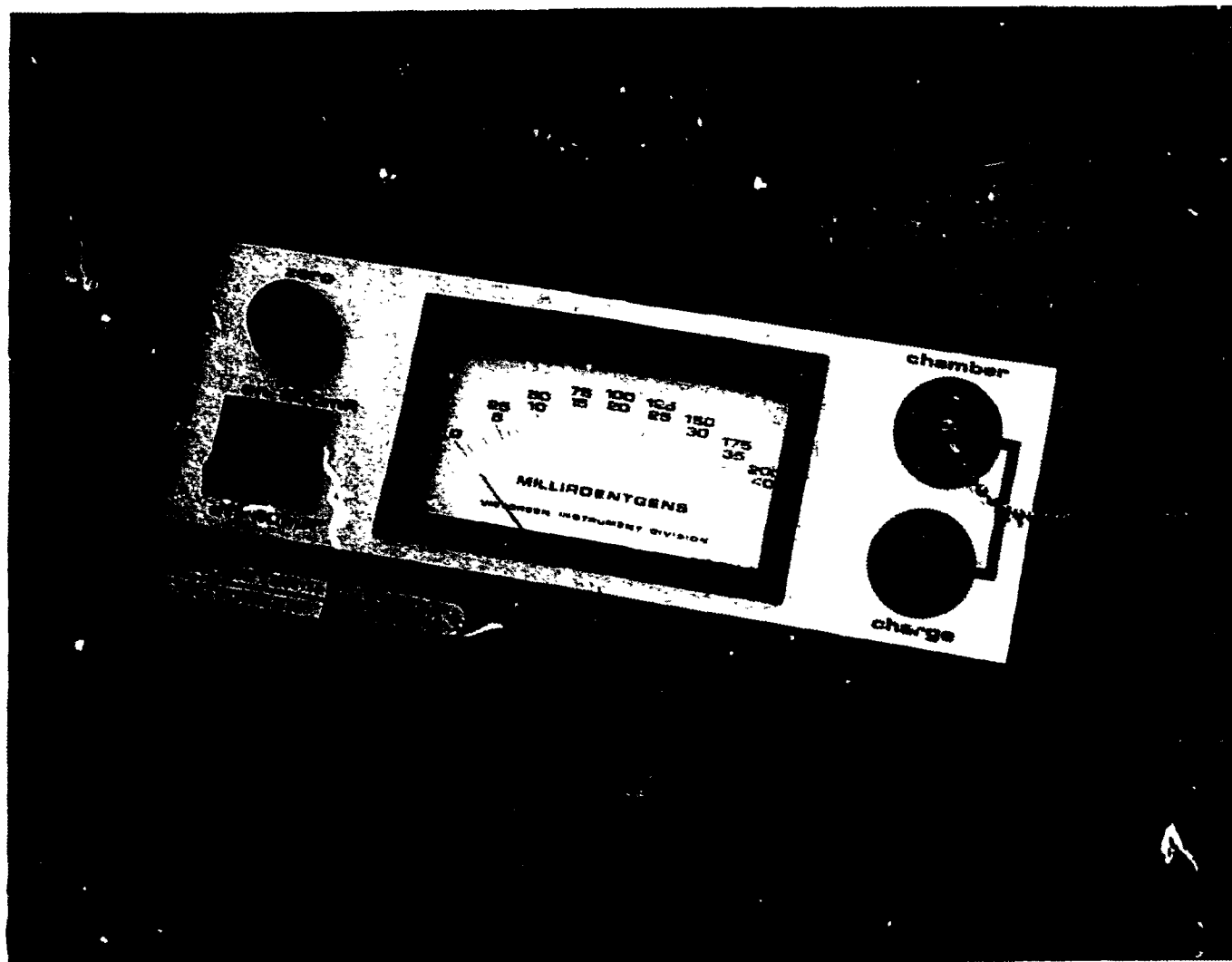


Fig. 3. The Minometer-II charger-reader

there is the likelihood that an individual's cumulative exposure may exceed the useful range of the pocket meter. Only one pair should be worn at any given time. At the end of the shift the meter pair(s) should be deposited in the user's pocket meter collection slot which has been labeled with his/her badge number. Casual users should consult the radiation surveyor assigned to his/her area, who will provide the user with a pocket meter envelope and instructions for return of the meters to the Radiation Dosimetry Group.

Readings obtained from pocket meters deployed longer than 24 hours are of questionable value because of slow current leakage with time. Therefore, any old or unused meters should not be worn, placed in a collection slot, or placed in a dispensing rack. They should be placed on or near the rack at the collection point, in one of the boxes provided for this purpose, or returned to a health physics surveyor.

CHARGING POCKET METERS

When the pocket meter is inserted into the charger-reader (minometer), the end of the meter's center electrode comes in contact with the clip of the charging socket. A charge is applied to the electrode by pressing the "charge" button on the minometer. The interaction of X or gamma radiation with the walls and air molecules in the pocket meter decreases the potential, and the detected change in charge is read out in units of exposure (mR).

For optimum performance, each pocket meter must be fully charged before use. The procedure for charging the meters and operating the minometer is described below.

1. Connect the power cord of the minometer to a standard 115-volt, 60-cycle outlet.
2. Turn the instrument on by pushing the ON-OFF switch to the ON position.

3. Allow the instrument to warm up for no less than five minutes before use.
4. Push the RANGE switch to the 200-mR position and zero the instrument by turning the ZERO ADJUSTMENT knob until the front panel meter reads "zero".
5. Insert a pocket meter into the chamber well.
6. Press and release the CHARGE button smoothly and slowly to charge the dosimeter. Remove the pocket meter carefully from the chamber well.
7. Charge a fully discharged meter, or one that has not been used for some weeks, for five to ten seconds in order to permit surface charge redistribution (on the insulators of the meter) to take place during the charging interval.
8. Re-zero the minometer periodically if many pocket meters are to be charged at one sitting.
9. Treat the fully charged pocket meters with care during deployment. Severe jostling or dropping will discharge the meters, resulting in erroneous final results.
10. Pocket meters are to be charged for use no longer than one hour before deployment. Unused meters are to be collected within 24 hours after deployment and recharged before being returned to service.

DEPLOYMENT OF POCKET METERS

Fully charged pocket meters are distributed and made available daily at several established pick-up points. Once each day, after 4:00 p.m., a Radiation Dosimetry Group representative will collect the "used" meters, as well as the "unused" meters at each station to be read out and/or recharged. The used meters will be kept in sequence related to the badge number of the user, which the collector records on form UCN-2130, "Pocket Meter Collection and Reading Sheet" (see Fig. 4). The collector then stocks each station with sufficient charged meters for use over the next 24 hours.

Table 1 is the list of distribution points as well as the number of meters required for 24-hour usage. Note that some of the distribution points do not maintain an inventory of charged meters but must still be checked each day so that used meters may be picked up for reading.

Table 1. Pocket meter distribution points and inventory of meters

Distribution point	Number of meters
Rust-1 Gate	80
Rust-2 (Building 7505)	30
DOSAR Facility	10
Building 6000	10
Building 6010	10
Building 7005	6
Building 7012 - two locations	6
Building 7002 - three locations	24
Building 7930 (TURF)	0 ^a
Building 7920 (TRU)	80
Building 7910 (HFIR) - two locations	50
Building 1505	10
West Portal	170
West Gate (South)	6
Building 2000	16
North Gate (8B)	150
Building 3042	0 ^a
Building 3104 - two locations	20
Building 3500	0 ^a
Building 3517	0 ^a
Building 3502	6
South Gate	20
Building 5505	10
East Gate	20
East Portal (Building 5000)	70
Building 3026	0 ^a
Building 3037	0 ^a

^aUsed meters must be picked up once per day, even though a charged inventory is not maintained at this distribution point.

READ-OUT OF POCKET METERS AND DATA REPORTING

In order to obtain maximum value from the pocket meter program, close attention must be paid to the read-out of each meter as well as the proper recording of data. The procedure to be followed is described below.

1. Turn on the minometer and allow it to warm up for at least five minutes before use.
2. Push the 200-mR RANGE switch on the minometer panel and "zero" the minometer.
3. Insert the first pocket meter of a pair into the chamber well.
4. Read the meter and record the reading (in mR) on form UCN-2130, "Pocket Meter Collection and Reading Sheet," in the slot designated by the badge number of the user of that pair.
5. Re-zero the minometer. (The minometer must be re-zeroed before inserting successive meters.)
6. Insert the second meter of the pair into the chamber well, read the meter and record that number onto form UCN-2130 in the same slot as #4. The second meter must be read, even if the first reading was zero.
7. If any reading is off the scale of the minometer, the symbol "OS" is recorded in the slot next to the user's badge number. (All meters which yield an off-scale reading are submitted to a voltage leak test and vibration test before being returned to service.) Any double-offscale (OS/OS) readings are reported to Radiation and Safety Surveys (R&SS) shift personnel who will collect that individual's badge for processing.
8. Remove meters from the chamber well slowly and smoothly.
9. If a pair of readings differs by greater than 30 mR, that pair of pocket meters is tied together with a rubber band and submitted for leak and vibration testing before being returned to service.

10. The reading process is a destructive one; therefore, successive readings will not be valid.
11. After all meters are read and recorded, each pair of readings whose lowest is 20 mR or greater is recorded along with badge number and department on form UCN-4816, "Pocket Meter Report" (see Fig. 5).
12. One copy of each "Pocket Meter Collection and Reading Sheet" is maintained in the Pocket Meter Lab at Building 2008. The originals are delivered to Building 4500S, Room H-257 for transmittal to the Computer Center.
13. Thirty-one copies of the "Pocket Meter Report" are made and delivered to the locations shown in Table 2.

Table 2. Pocket meter report sheet delivery points

Delivery point	Number of copies
Building 4500S (R&SS Department Head)	4
Building 4500S (Dosimetry Records Group)	1
Building 3550 (Survey Office)	5
Building 3001 (Survey Office)	5
Building 3047 (Survey Office)	3
Building 3038 (Survey Office)	2
Building 2008 (Shift Office)	3
Building 2008 (Radiation Dosimetry Group Leader)	1
Building 2026 (in the door)	2
Building 4500N (Shift Office)	2
RUST ^a	1 ^a

^aAn extra copy of the RUST sheet is delivered to the Shift Office, Building 2008.

POCKET METER COLLECTION AND READING SHEET

DATE READ		SHIFT		EDP DATE							
READ BY		TOTAL PAIRS		METER STATIONS							
READ AT				<input type="checkbox"/> WEST PORTAL <input type="checkbox"/> 2518 CHANGE HOUSE <input type="checkbox"/> CONST. <input type="checkbox"/> EAST PORTAL <input type="checkbox"/> Y-12 <input type="checkbox"/> EAST PORTAL <input type="checkbox"/> Y-12 <input type="checkbox"/>							
	EMPLOYEE NO.	mi		EMPLOYEE NO.	mi		EMPLOYEE NO.	mi		EMPLOYEE NO.	mi
1		26		51			76				
2		27		52			77				
3		28		53			78				
4		29		54			79				
5		30		55			80				
6		31		56			81				
7		32		57			82				
8		33		58			83				
9		34		59			84				
10		35		60			85				
11		36		61			86				
12		37		62			87				
13		38		63			88				
14		39		64			89				
15		40		65			90				
16		41		66			91				
17		42		67			92				
18		43		68			93				
19		44		69			94				
20		45		70			95				
21		46		71			96				
22		47		72			97				
23		48		73			98				
24		49		74			99				
25		50		75			100				

UCN-2150 (3 9-79)

Fig. 5. Pocket meter report

TESTING AND REPAIR

On a monthly basis, 100 pocket meters are removed from the operating inventory, tested, repaired if possible or needed, marked, and returned to operation. New meters and those rejected for use for any reason are treated similarly upon demand. The following is a listing of procedures to be followed.

TESTING

Leakage

Fully charge each pocket meter and store them carefully for 24 hours. At the end of that time, read each meter on a minometer. If a meter has discharged to 5 mR or greater on the minometer scale, it must be repaired before being returned to service.

Vibration

Fully charge each pocket meter and place them in the vibration unit holder. Run the vibration unit for one minute, then read each meter. If a meter has discharged to 5 mR or greater on the minometer scale, it must be repaired before being returned to service.

Calibration

Fully charge each pocket meter to be calibrated and place them in the Gamma Ring at the Calibrations Facility (Bldg. 2007). The ring will accommodate up to 33 meters per exposure. (Standard radiation safety measures, as described in The ORNL Calibrations Facility (ORNL/TM-8405), must be followed. No unauthorized personnel are allowed in the source area.) Expose each meter to 100 mR of gamma

radiation. Upon read-out, each meter must read 100 ± 10 mR on the minometer scale (90-110 mR) before being returned to service.

Minometer Calibration

On a weekly basis, a set of test pocket meters known to be fully operational are exposed to 100 mR of gamma radiation and read out (three each) on every minometer in routine use. If the meter readings are less than 90 mR or greater than 110 mR, that minometer is returned to the Calibrations Facility for repair and service.

Logbook

Log all actions in a logbook maintained for this purpose.

REPAIR

Leakage

Excess leakage (greater than 5 mR/24 h) after a pocket meter has been fully charged may be due to moisture within the chamber. This condition is remedied by removing the dust cap and warming the chamber at a temperature of 100 F until thoroughly dry.

Removal of Dirt

Any foreign matter entering the open end of a pocket meter may be removed by means of a blast of clean, dry air. An ear syringe that has a relatively small nozzle is ideal for this purpose.

Electrode Status

The electrode contact of each pocket meter should be free of nicks and dents in order to respond properly. The electrode itself should

seat firmly within the chamber of the meter and secured with a retainer ring. (A loose electrode will cause a pocket meter to leak excessively.) If either of the above are noted, remove the electrode and retainer ring carefully with a pair of needle-nose pliers. Insert a new electrode into the chamber, being careful not to damage the contact, and seat the retainer ring securely.

Dust Caps

The dust caps should be tightly inserted and removed only when necessary. Loose caps should be removed and tighter ones installed. Dust caps should be kept free of dirt and dust.

Replacement Parts

A supply of replacement electrodes, retainer rings and dust caps are kept in the Pocket Meter Laboratory at Bldg. 2008. Because the cost of replacement parts are almost as high as the cost of a new meter serious consideration should be given to discarding an obviously inferior pocket meter. Technicians should attempt interchange of parts if possible. (For example, a loose electrode in one meter may fit well into another.) Parts and meters should be discarded only if shown to be inferior after thorough testing and parts interchange.

INTERNAL DISTRIBUTION

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| 1. | H. C. Austin | 38. | T. W. Oakes |
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