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Industrial Safety and Applied Health Physics Division

THE ORNL CALIBRATIONS FACILITY

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operated by
UNION CARBIDE CORPORATION
for the
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ABSTRACT

The ORNL Calibrations Facility is operated by the Instrumentation Group of the Industrial Safety and Applied Health Physics Division. Its primary purpose is to maintain radiation calibration standards for calibration of ORNL health physics instruments and personnel dosimeters. This report includes a discussion of the radioactive sources and ancillary equipment in use and a step-by-step procedure for calibration of those survey instruments and personnel dosimeters in routine use at ORNL.

1. INTRODUCTION

The Calibrations Facility at Oak Ridge National Laboratory is operated by the Instrumentation group of the Industrial Safety and Applied Health Physics Division (IS&AHP). Its primary purpose is to maintain radiation calibration standards for IS&AHP by means of radioactive sources that provide alpha and beta particles, gamma rays and neutrons for calibration of ORNL health physics instruments and personnel dosimeters. The facility is equipped with several sources (such as ^{226}Ra, ^{252}Cf, $^{239}PuBe$, ^{204}Tl, ^{203}Tl and ^{239}Pu, some of which are traceable to NBS standards); mechanized, remote-control calibration equipment (such as a gamma well and TLD dosimeter "ring" devices); and well-established procedures to ensure precision in routine calibrations. In addition, field support in the form of a pick-up and delivery service is provided for the field survey offices.

This document includes a short discussion on the radioactive sources and ancillary equipment as well as step-by-step procedures for calibrating those radiation survey instruments and personnel dosimeters in routine use at ORNL. It is not intended to be an instructional guide, since operation of the facility requires familiarity with the basic procedures, but serves to document current procedures for future reviews and for the purpose of providing refresher information to Calibrations staff.

A detailed discussion of the instruments in use at ORNL can be found in ORNL-332, Health Physics Instrument Manual. Model numbers quoted in this report refer to that publication.

2. RADIATION SOURCE INVENTORY

The radiation sources located at the ORNL Calibrations facility are used for producing beta, gamma and neutron radiation fields for which the exposure or dose rate can be calculated as a function of the activity of the source and/or the distance between the source and the instrument being calibrated. An inventory of some of these sources can be found in Table 1. Other sources available for use are disk sources of electroplated alpha emitter (generally ^{239}Pu), and small-diameter beta sources of ^{204}Tl and ^{203}Tl, each identified by disintegration rate.

In order to keep radiation doses to calibrations personnel as low as reasonably achievable, particulary when using the large radium sources, basic health physics practices (such as distance, time and shielding) are followed. For example, the source in the gamma well is always lowered after each use. Calibration procedures performed with the source approaching its maximum position are done quickly and the source lowered immediately after completion of the procedure. Personnel do not lean over the well. When using the gamma ring, personnel leave the immediate area while the source is exposed. Common sense practices such as these result in negligible radiation doses to calibrations personnel.

Table 1

Special Nuclear Material and Precious Metal Inventory
Available for Calibration Procedures

Gamma Sources

Source No.	Description (mg Ra)	Location	Exposure Rate (mR/h)	Exposure Rate (μC/kg·h @ 1 m)
E-864	936.5[a]	gamma "well"	810[b]	210[b]
E-863	478.3[a]	gamma "ring"	410[b]	110[b]
E-862	101.4[a]	gamma "ring"	87[b]	22[b]
E-861	49.3[a]	vault locker 1	38[b]	9.8[b]
CLC	25	vault locker 1	20[c]	5.1[c]
E-859	10	vault locker 2	7.9[c]	2.0[c]
E-1268	5.1	vault locker 2	4.4[c]	1.1[c]
334 G	2	vault locker 3	1.6[c]	0.41[c]
E-857	1.07[a]	GMSM table	0.93[b]	0.24[b]
334 E	0.93	vault locker 3	0.80[c]	0.21[c]
334 B	0.184	vault locker 3	0.15[c]	0.04[c]
334 A	0.1	vault locker 3	0.02[c]	0.005[c]

Neutron Sources

Source No.	Description	Location	Dose Equivalent Rate (mrem/h)	Dose Equivalent Rate (μSv/h) @ 1 m
SNM 12503	^{238}PuBe	vault (paraffin drum)	23.4[d]	234[d]
NSD 105	^{252}Cf	vault locker 4	15.3[e]	153[e]

[a]Traceable to NBS standard and corrected for decay.

[b]Calculated exposure rate of unencapsulated ("uncanned") source neglecting self-absorption and air attenuation.

[c]Calculated exposure rate based on Victoreen R-Chamber measurements.

[d]Calculated value based on neutron emission measurements made by E. B. Wagner DOSAR Facility, ORNL, 1969.

[e]Calculated value based on neutron emission measurements made by J. E. Bigelow, TRU Facility, 1978.

3. CALIBRATION EQUIPMENT

The equipment at the ORNL Calibrations Facility includes a gamma well, a gamma ring, and various table-top setups which are marked for positioning of sources and instruments.

3.1 Gamma Ring

The gamma ring is a device used for calibration of badge dosimeters, pocket ionization chambers, and hand meters. Figure 1 is a photograph of the badge mounting ring, source tube and source storage shield. Figure 2 is a photograph of the operating console. Figure 3 is a block diagram of the functional parts.

When not in operation, the source is situated within the lead shield. The source is raised from the shield to a stop at the top of the plastic tube when the vacuum pump is switched on. The timers may be set for exposure periods ranging from less than one minute to twenty-four hours. At the end of the pre-set exposure period, the vacuum pump is shut off automatically, and the source drops into the shield.

The exhaust gas from the pump is filtered through two oil and wool-fiber filters and then passed through a paper filter which is located at the window of a GM tube. This tube is connected to a count-rate meter and a relay which will actuate an alarm if the count rate exceeds a pre-set level.

The source shield accommodates two sources, 98.5 mCi (3.6 GBq) and 500 mCi (18.5 GBq) of radium, either of which may be selected by a switching device. A listing of the exposure time required to produce various integrated exposures to dosimeters situated 15.0 or 30.5 cm from the raised source is posted at the Calibrations facility.

ORNL Photo 51922

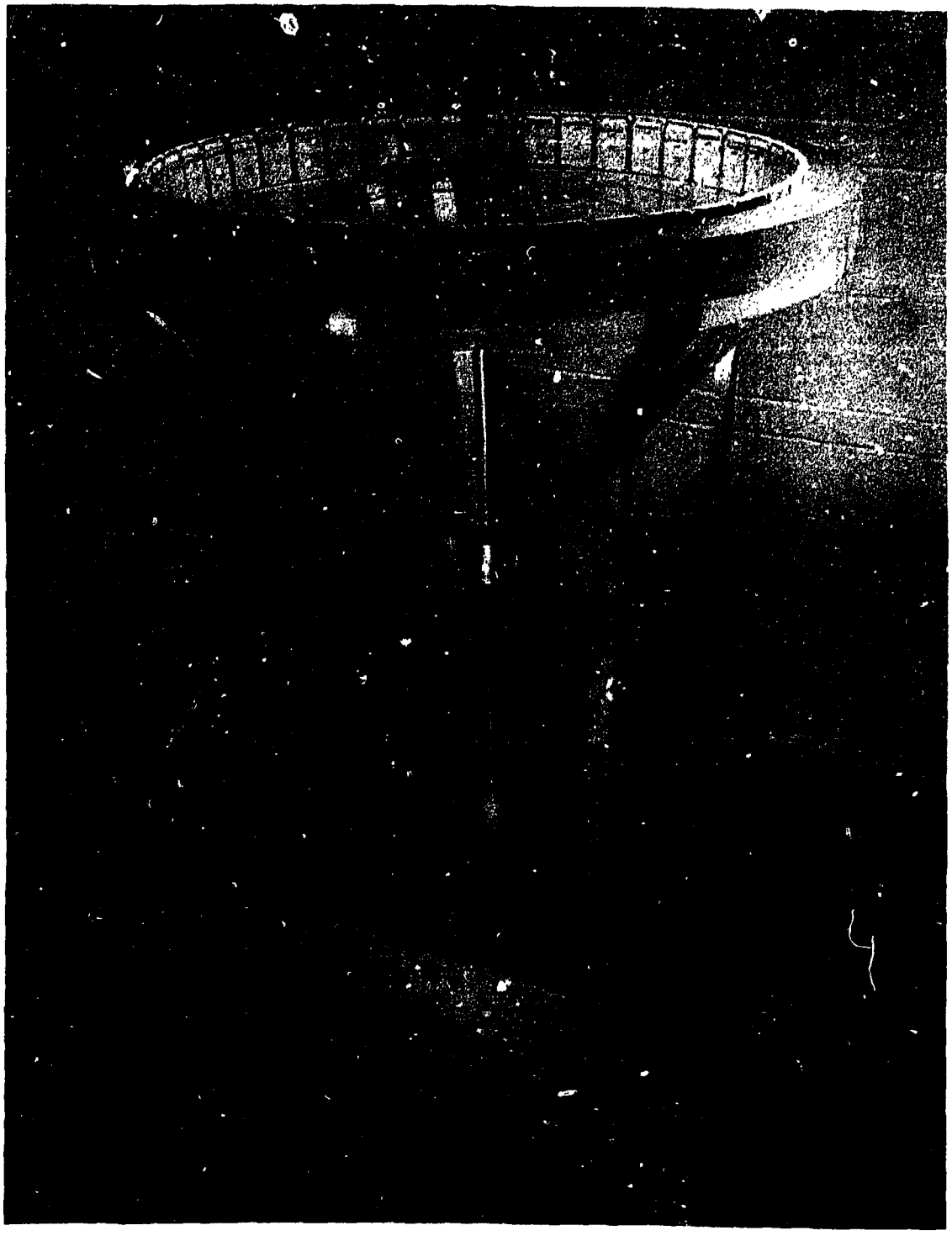


Figure 1. Badge mounting ring, source tube and source storage shield.

ORNL Photo 12046

Figure 2. Operating console for the gamma ring.

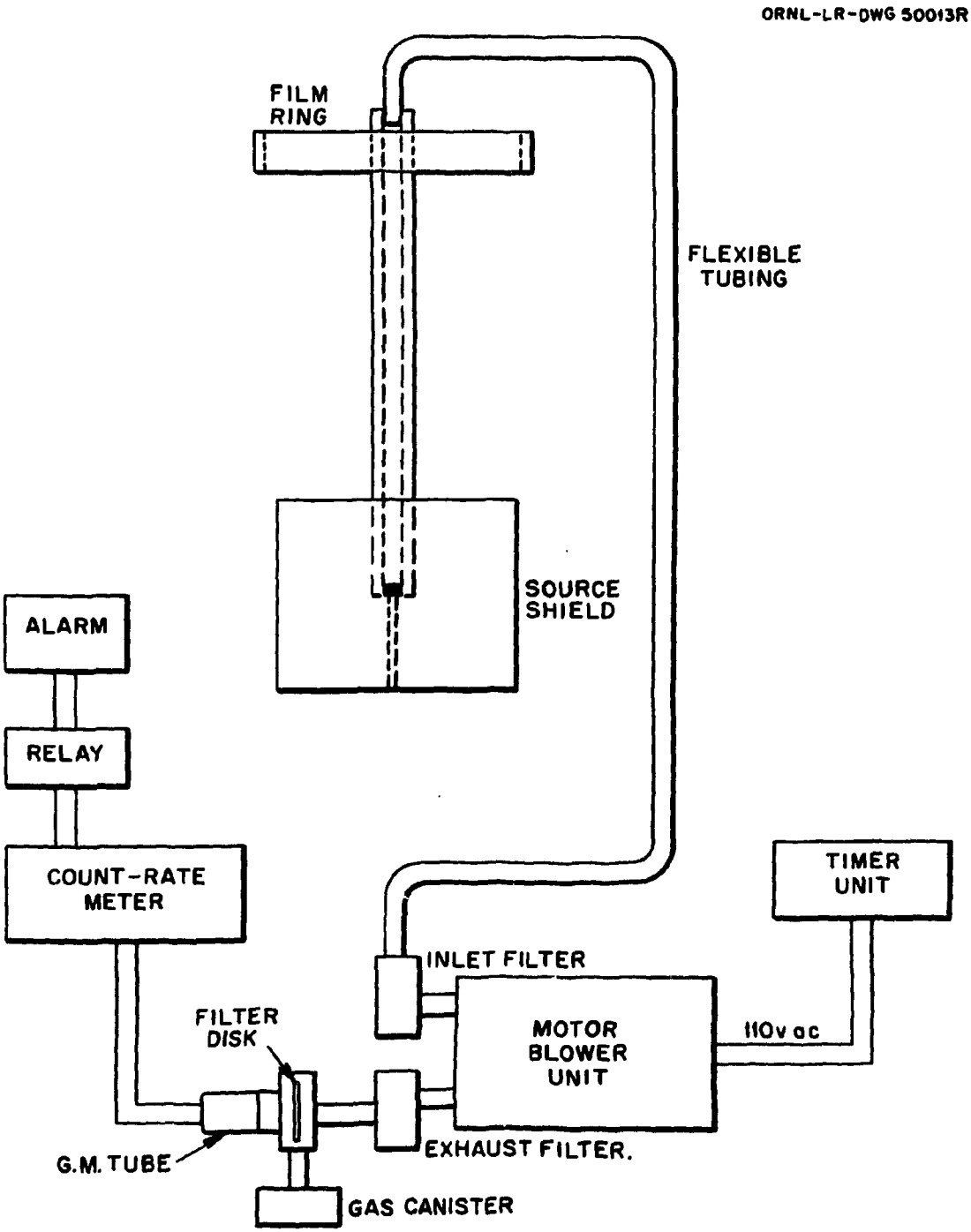


Figure 3. Block diagram of functional parts of the gamma ring.

3.2 Gamma Well

The gamma well is used primarily for calibration of ionization chambers and as a check for GM survey instruments. Figure 4 is a photograph of the well. The radiation dose rate at the position occupied by the instrument is determined by a primary calibration. Due to the collimation and filtration applied, close agreement with the inverse-square law is obtained.

The plastic platform (or "sled") serves three functions: (1) as a support for the instrument, (2) as a means of transporting instruments between the operator and the proper position over the well, and (3) as the prescribed thickness of air-equivalent material necessary for assuring that the secondary radiation is in equilibrium with the medium (air) in which it is being measured. The moveable lead filter may be used to reduce the radiation intensity by a factor of approximately five.

By means of the controls on the operator's panel, the source can be adjusted to various heights which are indicated on a mechanical register. Table 2 shows the approximate exposure-rate with the source positioned at some of these distances.

Figure 5 is a sectional view of the gamma well. The well is 5 meters deep, which serves to minimize the time required for calibration and to reduce the radiation exposure to personnel. A 1 g radium capsule is currently in place in the source holder.

3.3 Table-Top Calibration Setups

The table-top setups consist of flat surfaces upon which lines have been drawn to facilitate positioning of radiation sources and/or detectors to achieve various exposure rates. Figure 6 is an example of one of these setups.

ORNL Photo 12027

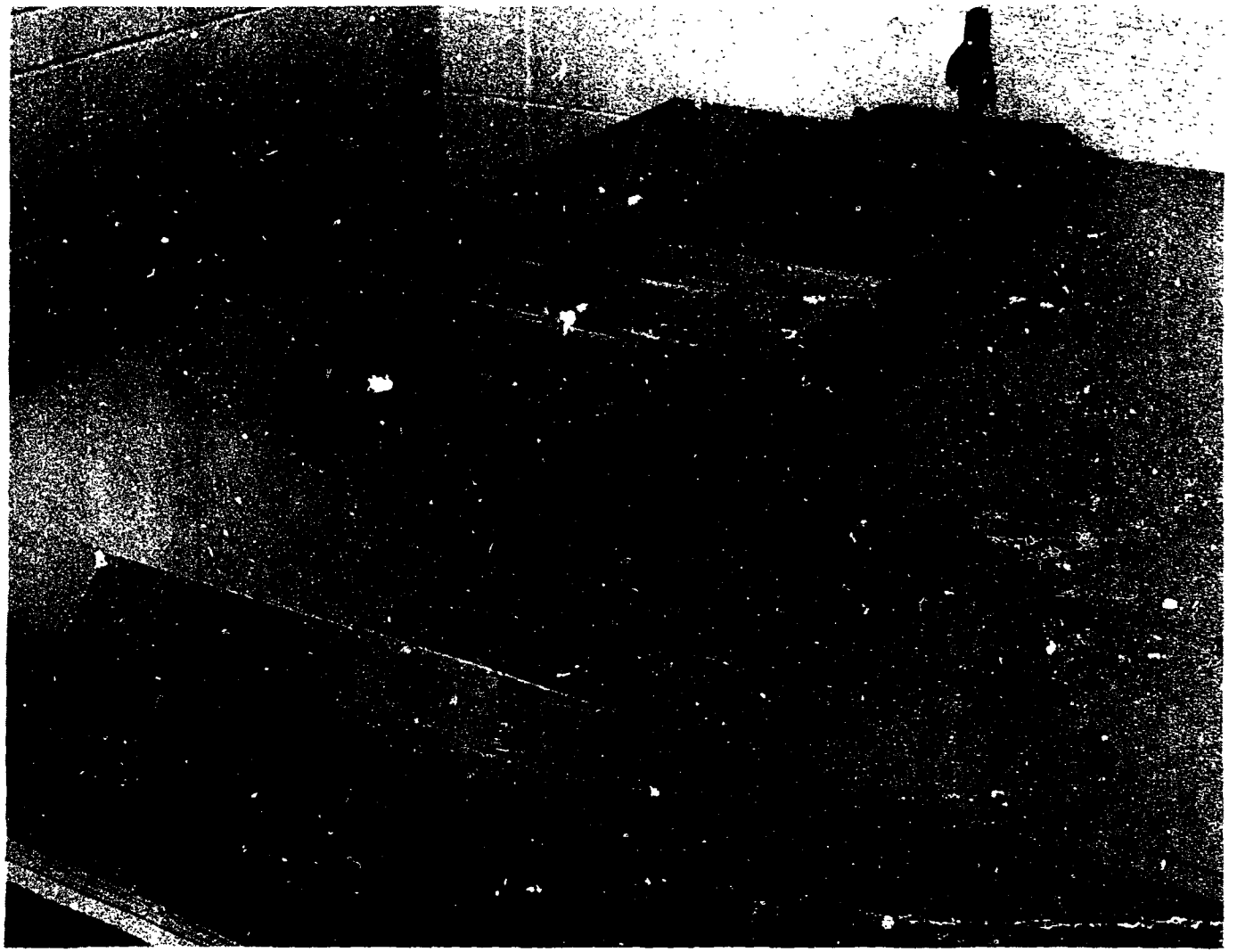


Figure 4. Photograph of the gamma well.

Table 2. Approximate Exposure Rate as a Function of Source Distance for the Gamma Well

Distance (cm)	Exposure Rate mR/h	Exposure Rate μC/kg·h
10	70,750	18,300
50	2,830	730
100	708	182
150	314	81
200	177	46
250	113	29

*Approximate exposure rates for other distances can be calculated by

$$R_1(d_1)^2 = R_2(d_2)^2$$

where

R_1 = exposure rate at position d_1

R_2 = exposure rate at position d_2

or

$$R_2 = \frac{R_1(d_1)^2}{(d_2)^2}$$

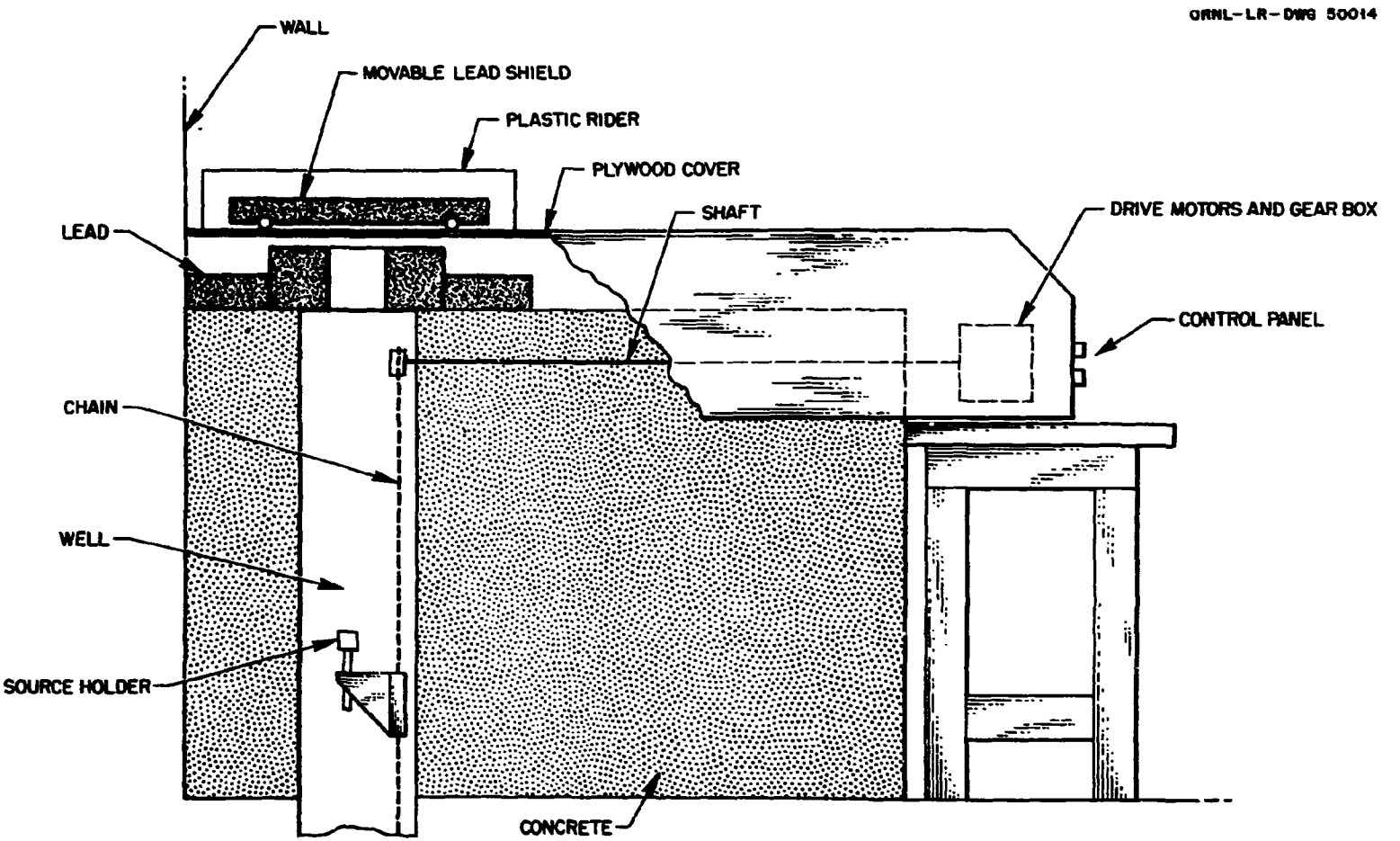


Figure 5. Sectional view of the gamma well.

ORNL Photo 8441

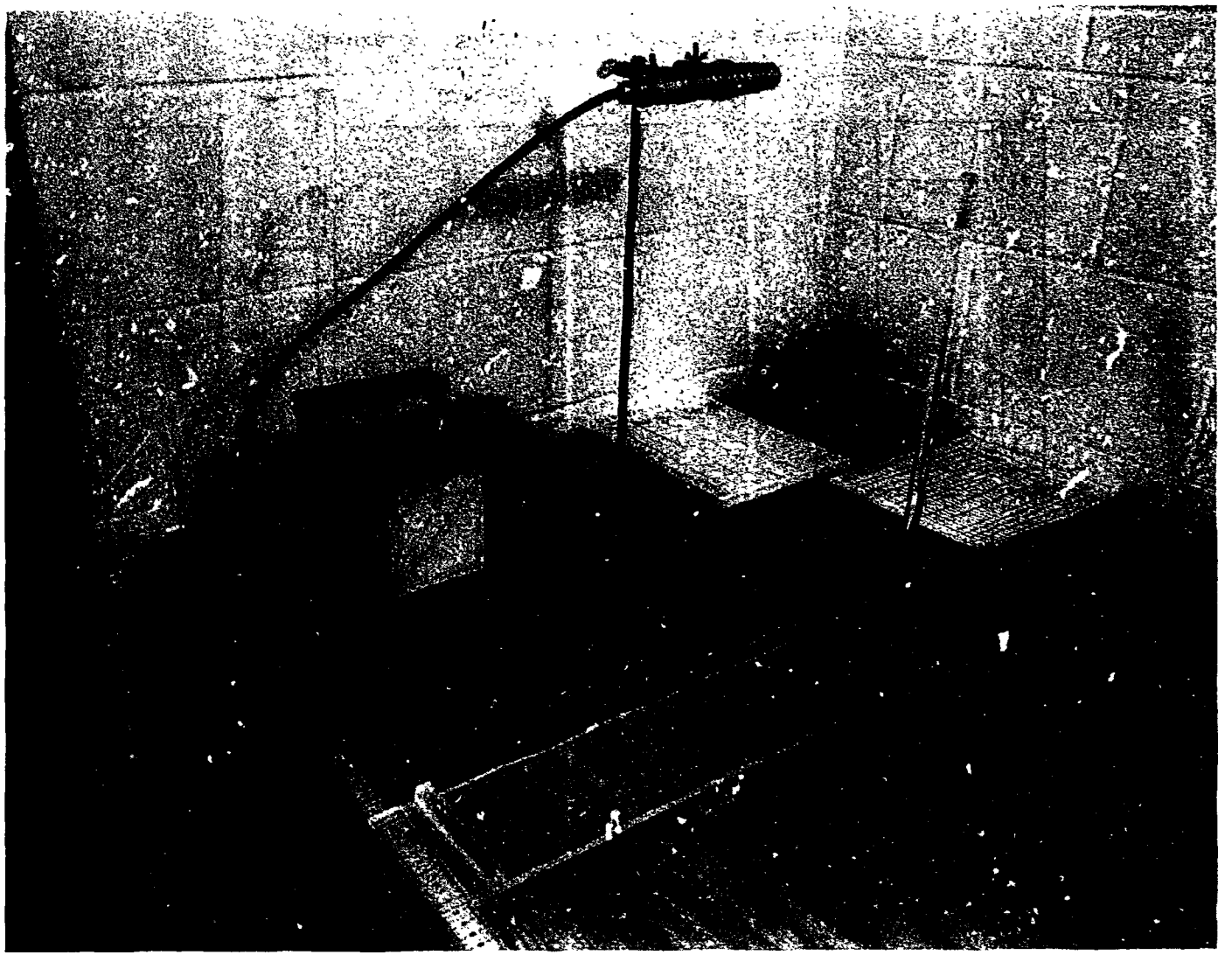


Figure 6. GMSM Calibration Setup.

4. CALIBRATION PROCEDURES

The following calibration procedures are for instruments in general use by the ORNL Radiation and Safety Surveys staff. (Instruments designed for a specific or limited application can also be calibrated at the facility but may require adjustments in routine procedure and are not discussed here.) These procedures are designed for use by an experienced metrologist and are not intended for use by persons unfamiliar with the calibrations facility.

Attention is paid to quality control while calibrating any instrument. Erroneous results may be obtained by:

- poor general laboratory procedures (e.g., carelessness, leaving unattended check sources about, etc.),
- mishandling or mistreating the apparatus,
- failure to check that equipment is operating properly,
- applying a calibration method that is unsuitable for the instrument being calibrated,
- misreading instruments and ancillary apparatus,
- computational errors,
- using incorrect values for correction factors.

If the metrologist follows the appropriate procedures, with emphasis on quality control, each instrument should be accurate to within ± 10% of true readings. Each instrument is allowed an appropriate warm-up time before being calibrated and, at the end of the procedure, all switches are returned to the "off" position (e.g., high voltage, gas flow, etc.).

4.1 Cutie-Pie Survey Meters

There are three basic types of Cutie Pie (ionization chamber) survey meters in use at ORNL: the standard model (Q-2299), the extended probe model, and the high-range model (see ORNL-332 for a description of each). These instruments are routinely serviced and calibrated every three to four months unless operational difficulties are noted prior to that time. After pre-calibration service, the following steps are taken before each instrument is returned to the field survey office.

1. Check the battery function. Return instrument for service if faulty.
2. With the switch set on "zero," let the instrument warm up for about three minutes.
3. Put the instrument on the lucite sled "window" and remove the cover over the calibration potentiometers.
4. Turn the "zero-adjust" to full-scale deflection and re-zero.
5. Check the zero setting for each range (x1, x10, x100). If the meter needle drifts significantly off the zero setting (greater than one division on the scale), leakage current may be excessive, requiring further service.
6. Position the lucite sled over the entrance to the "well," and perform the following series of checks and/or adjustments for the model being calibrated.

Range Setting	Source Distance (cm)	Dose Rate Reading	Other*
	Standard Model		
x1	107.4	90 mrad/hr	a,b
x1	101.4	100 mrad/hr	a,b
x1	150.0	50 mrad/hr	a,c
x10	100.0	750 mrad/hr	b
x10	85.0	1000 mrad/hr	c
x10	123.5	500 mrad/hr	c
x100	23.0	10,000 mrad/hr	b
x100	33.5	5,000 mrad/hr	c
	Extended Probe Model		
x1	92.5	0.9 rad/hr	b
x1	87.2	1.0 rad/hr	c
x1	125.6	0.5 rad/hr	c
x10	29.2	7.5 rad/hr	b
x10	25.3	10.0 rad/hr	c
x10	35.9	5.0 rad/hr	c
x100	10.2	50.0 rad/hr	b
x100	17.4	20.0 rad/hr	c
	High Range Model		
x1	31.5	1.0 rad/hr	b,d
x1	29.9	10.0 rad/hr	c,d
x1	40.5	5.0 rad/hr	c,d
x10	12.8	75.0 rad/hr	b,d
x10	11.4	100.0 rad/hr	c,d
x10	15.0	50.0 rad/hr	c,d
x100	11.4	100.0 rad/hr	b,d

* a = Put lead shield between "well" entrance and lucite sled

b = Adjust calibration potentiometer to obtain this dose rate reading for this range setting.

c = Check dose rate reading only. Do not adjust the calibration potentiometer. Scale readings should be within $\pm$10% of the dose rate readings.

d = Use auxillary lucite sheet rather than the lucite sled under the instrument.

7. Turn the instrument off. (If the instrument will not calibrate satisfactorily and/or the dose rate readings are not within ±10% of the recommended readings, return the instrument for further service).
8. Log calibration information on form UCN-2404.
9. File in "elapsed" form UCN-2866, date-stamp form UCN-2867, and attach a date-stamped label to the instrument.
10. Date and initial a "new" form UCN-2866 and return it to the field survey office with the instrument.
11. Return "elapsed" form UCN-2866 and form UCN-2404 for keypunching.

4.2 Calibration Procedure for Side-Window Geiger-Mueller Survey Meters

There are three basic types of side window Geiger-Mueller (GM) survey meters in use at ORNL; Model Q-2092, Model Q-5218, and Eberline Model 140. Although these instruments are calibrated to give an approximation of count rate as a function of exposure rate, they are not intended to be used as dose-rate meters. After pre-calibration servicing, which includes linearity check and adjustment using a pulse generator, the instruments are calibrated by the following procedure:

1. Check battery status. If faulty, return instrument for servicing.
2. Using the "table-top" setup with radium source number E-857 (1.06 μg), place the probe (with the shield closed) in the holder.
3. Record the response of the instrument, in counts/min. versus the following exposure rates on form UCN-2404:

Source Distance (cm)	Exposure Rate (μR/h)	(μC/kg·h)	Range Setting	Recommended Response (±10%) counts/min)
98.6	1	.258	5K	3,100
29.0	10	2.58	50K	27,000
105.2*	100	25.8	500K	300,000

*Use the calibration well with the source at this distance, and the lead shield between the well entrance and the lucite sled. This step is for Models Q-2092 and Q-5218 only.

4. Return the instrument for further service if the response exceeds ±10% of the recommended values.
5. Date-stamp the instrument and affix a label indicating approximate counts/min per mR/h for radium gammas.
6. Date-stamp Calibration Card UCN-2867. Carefully observe HP- and X-numbers.

4.3 Calibration Procedure for End-Window Geiger-Mueller Survey Meters

There are two basic types of end-window GM survey meters in use at ORNL for detection of beta, and gamma radiations; Model Q-2826 and Eberline Model 140/EW. These instruments are not intended for dose rate measurements. After pre-calibration servicing, which includes check and adjustment for linearity using a pulse generator, the instruments are given an operational check by the following procedure:

1. Check the battery status. If faulty, return instrument for servicing.
2. Place the probe on a radium check source.
3. Record the response of the instrument on form UCN-2404 for the x1, x10, and x100 ranges.
4. Date-stamp Calibration Card UCN-2867. Carefully observe HP- and X-numbers.
5. Initial and date a new form UCN-2866, and return it with the instrument to the field survey office. Carefully observe HP- and X-numbers.
6. Return elapsed form UCN-2866 and form UCN-2404 for keypunching.

4.4 Calibration Procedure for Beta-Dosimeter Survey Instrument

These instruments (Model Q-2826) are collimated end-window GM survey meters and are calibrated to read beta dose-rate in μGy/h. After pre-calibration servicing, to include a linearity check and adjustment, they are calibrated by the following procedure:

1. Check the battery status. If faulty, return the instrument for servicing.
2. Place a ^{204}Tl source (source # 4) or ^{203}Tl (source # 5) on the end of the probe.
3. Connect the instrument to a scaler after setting the range at the x100 position.
4. Counts are integrated over a one-minute and two-minute period, respectively, and recorded on form UCN-2404. Record both the meter reading and the scaler reading.
5. Record the activity of the source, after correcting for radioactive decay, on form UCN-2404.
6. Date-stamp each instrument and affix a label indicating approximate count/min per μGy/h.
7. Date-stamp Calibration Card, UCN-2867. Carefully observe HP- and X-numbers.
8. Initial and date a new form UCN-2866, and return it with each instrument to the field survey offices. Carefully observe HP- and X-numbers.
9. Return elapsed form UCN-2866 and form UCN-2404 for keypunching.

4.5 Calibration Procedure for Gas Flow Proportional Counters

The two models of the gas flow proportional counter in use at ORNL are the Eberline PAC-3G and PAC-4G. (The PAC-4G differs from the PAC-3G only in the fact that it has 4 range settings.) Close attention must be paid to the gas content and flow rate while calibrating these instruments in order to ensure optimum operating conditions. After pre-calibration servicing, which includes a linearity check, high voltage adjustment and discriminator adjustment (to ensure maximum sensitivity for particulate radiations while adequately discriminating against gamma radiation) the instruments are calibrated by the following procedure:

1. Turn the gas regulator knob to "flush" for 3-5 minutes.
2. Check the flow of gas by touching a lit match to the small gas vent at the tip of the probe. The flame should be about 1-1/2 inches (3.8 cm) in height.
3. Place the gas regulator knob in the "operate" position. The flame should drop in height to about 1/2 inch (1.3 cm). If faulty, return instrument for further service.
4. Extinguish the flame and plug a scaler into the "phone" output of the instrument. (A clipping circuit may be necessary.)
5. Take a two-minute background count. The meter reading and scaler reading should be less than 6 counts/min. (If unsatisfactory, check gas flow or return instrument for further service.) Record background values on form UCN-2404.
6. Using the plated ^{239}Pu sources listed below, record the meter and scaler readings for a 2 minute count on form UCN-2404.

Instrument Model Number	Source (disintegrations/min)	Range
PAC-3G	4,392	x1
PAC-3G	15,358	x10
PAC-3G	166,058	x100
PAC-4G	2,068	x1
PAC-4G	15,358	x10
PAC-4G	166,058	x100
PAC-4G	166,058	x1000
PAC-4G	260,180	x1000

7. Calculate the number of disintegrations per count for the meter and scaler readings for each range and record these values on form UCN-2404.
8. Calculate the mean valve of disintegrations per count for the meter reading and record it on a sticker affixed to the instrument.
9. Turn off the gas.
10. Date-stamp Calibration Card, UCN-2867. Carefully observe HP- and X-numbers.
11. Initial and date a new form UCN-2866 and return it with each instrument to the field survey offices. Carefully observe HP- and X-numbers.
12. Return elapsed form UCN-2866 and form UCN-2404 for keypunching.

4.6 Calibration Procedure for Portable Alpha Scintillation Counter

These instruments (Model Q-1975) use a probe of ORNL design, commonly known as a "beer mug" probe. After pre-calibration servicing, which includes a linearity check, high voltage adjustment, and discriminator adjustment (to ensure optimum sensitivity for alpha radiation while adequately discriminating against gamma radiation), the instruments are calibrated by the following procedure:

1. In the operating mode, check the mylar window for light leaks. Rapid register repetition rate with no source present is indicative of a light leak. Should this occur, return the instrument for further servicing.
2. Check the background count rate during a two minute period. If there are greater than 5 register repetitions per minute, return the instrument for further servicing.
3. Place the probe on the plated ^{239}Pu source labeled "1150 disintegrations/second."
4. Observe the register repetition rate for a one minute and two-minute count period, respectively. There should be approximately 145 to 183 counts per minute.
5. Record the background reading (in reg./min) and the source readings on form UCN-2404.
6. Calculate the number of disintegrations per register. Record this number on form UCN-2404 and on a small sticker, to be affixed to the instrument.
7. Place a black plastic seal around the probe connector.
8. Date-stamp Calibration Card, UCN-2867. Carefully observe HP- and X-numbers.
9. Initial and date a new form UCN-2866 and return it with each instrument to the field survey office. Carefully observe HP- and X-numbers.
10. Return elapsed form UCN-2866 and form UCN-2404 for keypunching.

4.7 Calibration Procedure for Thermal Neutron Survey Meter

This instrument (Models Q-2824 and Q-2004) is used for measuring thermal neutron fluence rate in n cm^{-2} sec^{-1}, and is relatively insensitive to gamma radiation. After pre-calibration servicing, which includes linearity check and adjustment, the instrument is calibrated by the following procedure:

1. Check battery function. If faulty, return for further service.
2. Place the detector tube in the center of the paraffin cylinder (radius = 11 cm) used for this calibration.
3. Position the bucket and the neutron source such that the neutron flux is 1250 n cm^{-2} sec^{-1}.
4. With the instrument range setting at x10, adjust the calibration control to obtain a meter reading of 1250 n cm^{-2} sec^{-1}. Record response on form UCN-2404.
5. Return instrument to the shop to have x1 and x100 ranges set with a pulse generator, in relation to pulse rate vs. meter reading on the x10 range.
6. Date-stamp the instrument.
7. Affix a sticker displaying the calibration value of 267 n cm^{-2} sec^{-1} = 1 mrem/h (0.01 mSv/h).
8. Date-stamp calibration card UCN-2867. Carefully observe HP- and X-numbers.
9. Initial and date a new form UCN-2866, ard return it with the instrument to the field survey office. Carefully observe HP- and X-numbers.
10. Return elapsed form UCN-2866 and form UCN-2404 for keypunching.

4.8 Calibration Procedure for Fast Neutron Survey Meter

This instrument (Model Q-2047) is a count rate meter calibrated in terms of mrem per hour. The detector is a proton recoil proportional counter. After pre-calibration servicing, the instrument is calibrated by the following procedure:

1. Check the battery function. If faulty, return for servicing. Allow instrument to warm up for 1-2 minutes.
2. With the range setting at 25, place the instrument over the gamma well with the source positioned to give a 3 R/h (774 μC/kg•h) exposure rate in order to check the gamma response of the instrument.
3. With a scaler attached to the instrument, the count rate should be between 15 and 30 counts per minute. If not, adjust the amplifier gain to achieve this rate.
4. Record response on form UCN-2404.
5. Position source in gamma well to give a 300 mR/h (77.4 μC/kg•h) exposure rate. Count rate on attached scaler should be less than 10 counts per minute. (If faulty, return instrument for further service.) Record response on form UCN-2404.
6. With scaler still attached, position the instrument on the table-top set-up so that the neutron source (number SNM 12503), in its moderator, gives a 10 mrem/h (0.1 mSv/h) dose rate (see Table 3).
7. The count rate on the scaler should be 150 ± 30 counts per minute. The repetition rate of the register on the instrument should be 70 ± 10 registers per minute. (If faulty, return for further service.) Record scaler and register response on form UCN-2404.
8. Position instrument so that it is receiving a 100 mrem/h (1 mSv/h) dose rate from the source. Record meter response (in mrem/h) on form UCN-2404 (see Table 3).

Table 3. Source-to-Detector Distance vs. Dose Equivalent Rate for ^{238}PuBe Source SNM 12503 in Paraffin Moderator

Dose Equivalent Rate (mrem/h)	(mSv/h)	Source-to-Detector* Distance (cm)
10	0.1	155
20	0.2	110
40	0.4	77.5
100	1.0	49
160	1.6	38.7
200	2.0	34.6

* Distance is measured from center of Paraffin Moderator to the detector probe.

9. Date stamp the instrument.
10. Affix a sticker on the instrument displaying the appropriate calibration. (If the above steps have been followed, this value should be 14 Registers/minute = 1 mrem/h.)
11. Date-stamp Calibration Card, UCN-2867. Carefully observe HP- and X-numbers.
12. Initial and date a new form UCN-2866 and return it with instrument to the field survey office. Carefully observe HP- and X-numbers.
13. Return elapsed form UCN-2866 and form UCN-2404 for keypunching.

5. PICK-UP AND DELIVERY SERVICE

A routine pick-up and delivery service is provided between the field survey offices, the Calibration facility, and the Radiation Monitoring analysis labs. Each afternoon, instruments which have been repaired and calibrated are returned to the field offices with the appropriate service data cards along with other accessory equipment. Material folders for field offices containing smear results, communications, etc., are picked up from the analysis labs (elevator, 4500S) and delivered with the instruments.

The current delivery points are as follows:

Building 4500S (elevator)
Building 4500S (D. R. Simpson, surveyor)
Building 4508 (R. E. Keny, surveyor)
Building 3517 (J. H. Spence, surveyor)
Building 3550 (D. G. Noe, surveyor)
Building 3047 (S. Hamley, surveyor)
Building 3038 (W. T. Martin, surveyor)
Building 2008 (C. R. Guinn, surveyor)
Building 3019 (C. H. Miller, surveyor)
Building 3001 (L. C. Johnson, surveyor)
Building 4500N (C. F. Zamzow, surveyor)
Building 5000 (Personnel Monitoring, A. B. Eldridge)
Building 4500S (Elevator)

As each office is visited, instruments, service data cards, and accessories in need of service are picked up to be returned to the Calibrations Facility.

At the completion of the route, the return material folders from the survey offices are left at the analysis lab (4500S).

For outlying health physics survey offices a similar pickup and delivery service is provided on Tuesday and Thursday mornings. The route is as follows:

Building 5505 (C. F. Haynes, surveyor)
Building 6000 (K. Wallace, surveyor)
Building 7710 (G. R. Patterson, surveyor)
Building 7900 (R. E. Coleman, surveyor)
Building 7920 (J. C. Richter, surveyor)

When each route is completed the instruments are returned to the Calibrations Facility, Building (2007), matched with the appropriate service data card, and placed in the instrument repair section for pre-calibration servicing.

APPENDIX A

FORMS

1. Health Physics Portable Instrument Service Data - UCN-2866

HEALTH PHYSICS PORTABLE INSTRUMENT SERVICE DATA

HP No. (6-13)	Property No. (17-23)	Calibration Data (25-30)	Calibrated By
Date Contamination Free (32-37)		By	
Date Serviced		Serviced By	
Date Calibrated (39-44)			
Additional Information :			

UCN-2866
(3 9-81)

AMICO 1381

At the time an instrument is initially assigned, and each time thereafter the instrument is returned to the HP area after having been serviced and calibrated, this Calibration Data Card is initiated and accompanies the instrument through its use and service cycle. It serves four purposes by providing calibration information to be input to the computer for the Annual Report (see Appendix C); the date of the last calibration; a reminder to the HP offices of when the instrument should be returned for its next calibration and service; and ensures that the instrument has been checked and found to be free of transferable contamination.

2. Calibration Card, UCN-2867

CALIBRATION CARD

P. X.

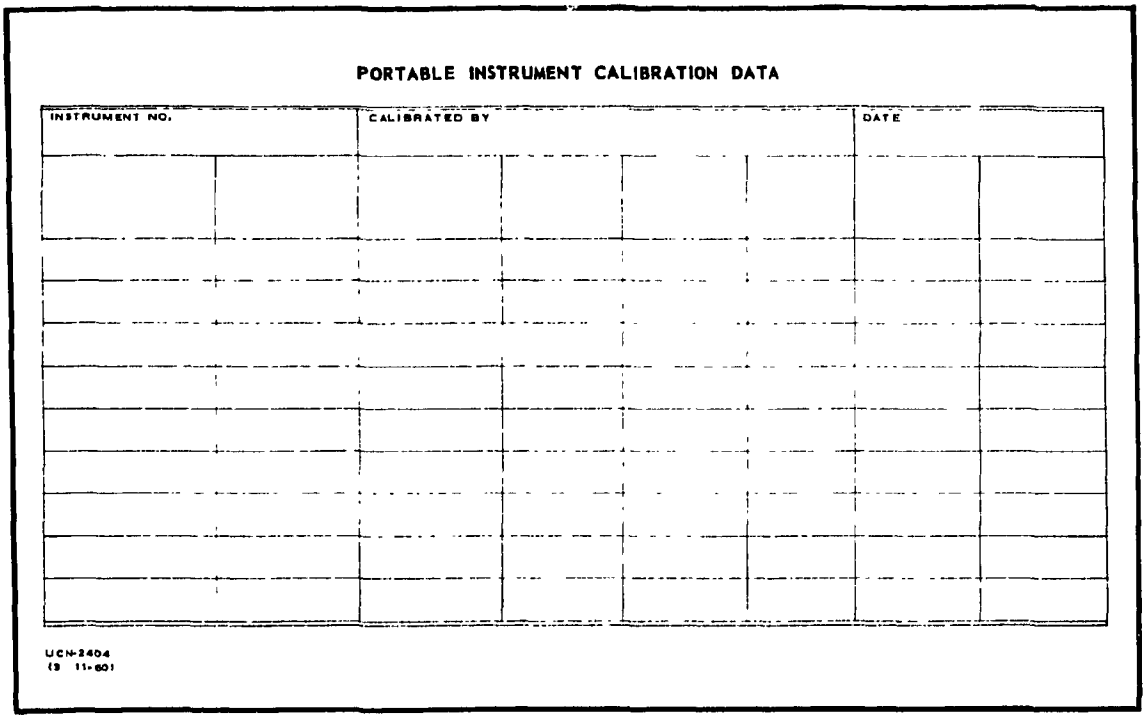
TYPE

CALIBRATION DATE	CALIBRATION DATE	CALIBRATION DATE

CN-2867
8-61)

This form, which is kept on file at the Calibrations Facility, provides an easily accessible record of when each instrument was calibrated.

3. Portable Instrument Calibration Data, UCN-2404



PORTABLE INSTRUMENT CALIBRATION DATA

INSTRUMENT NO.		CALIBRATED BY				DATE	

UCN-2404
(3 11-60)

This form is used to record the response of each instrument to the appropriate calibration procedure. It is maintained at the Calibration's facility for approximately two years.

APPENDIX B

INSTRUMENT TYPE CODE SYMBOLS FOR HEALTH PHYSICS PORTABLE INSTRUMENT PROGRAM

HP Code	Type Code	Model
X	A1	Alpha Survey Meter, Air Prop. (Q-2912)
A	A2	Eberline, PAC-3G
A	A3	Eberline, PAC-4G
S	A4	Alpha Scintillation Counter (Q-1975)
S	A5	Alpha Scintillation Counter (Q-2789)
S	A6	Q-2789, Eberline Probe
C	C2	Cutie Pie, Victoreen
C	C3	Cutie Pie, NRC CPID
C	C4	Cutie Pie, ORNL/NEC Mod. 2
C	C5	Cutie Pie, (Q-2299)
C	C6	Cutie Pie, Ext. Probe
C	C7	Cutie Pie, Hi-Range
G	G1	GMSM, Eberline 140
G	G5	GMSM (Q-2092)
G	G7	GMSM (Q-5218)
G	E1	GMSM, Eberline 140, End Window
G	E3	GMSM (Q-2826), End Window
F	N1	Fast Neutron Survey Meter (Q-2047)
T	N2	Thermal Neutron Survey Meter (Q-2004)
T	N3	Thermal Neutron Survey Meter (Q-2824)
M	M1	Miscellaneous

APPENDIX C

ANNUAL REPORT

Information from form UCN-2866 (see Appendix A) is keypunched to form a file for all instrument calibrations and service cycles. At the end of each calendar year, a computer-programmed report is prepared which includes:

a. Instrument listing in order of property number, HP number (including instrument type, acquisition date or initial use date, acquisition cost, accountable division, and date of retirement, if applicable),
b. Summary of calibration history,
c. Elapsed time in and out of service during the year,
d. Listing of instruments of advanced age or which require excessive maintenance,
e. Listing of instruments which were not physically inventoried by the Calibrations Facility during the year.
f. Instruments added or deleted during the year.

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