

# ADVANCED MEDICAL SYSTEMS OPERATING PROCEDURE

## CALIBRATION OF PORTABLE RADIATION DETECTION INSTRUMENTS

ISP-23 Rev. 1/95

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- 1.0 PURPOSE: The purpose of the procedure is to provide uniform and documented proof of calibration of the survey instruments and dosimeters used.
- 2.0 PRECAUTIONS AND LIMITATIONS:
  - 2.1 This procedure applies to all survey meters and dosimeters in active use.
  - 2.2 Calibration sources are to be stored only in Controlled Areas of the Isotope Facility.
  - 2.3 Film badges and pocket dosimeters should be worn when calibrating equipment.
  - 2.4 Keep as much distance from the calibration source as possible.
- 3.0 INSTRUCTIONS:
  - 3.1 Calibration of Portable Survey Meters
    - 3.1.1 Ensure meter is free of removable contamination and  $<1\text{mR/hr}$  fixed contamination.
    - 3.1.2 Package the meter for shipment.
    - 3.1.3 Ship the meter to a vendor for calibration.

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### 3.2 Calibration of Pocket Dosimeters.

- 3.2.1 Dosimeters may be calibrated in two ways:
  - a. Use of an outside calibration service.
  - b. Use of a commercially available dosimeter calibrator.
- 3.2.2 Set the dosimeter to zero and record the serial number on Form ISP-23A, Dosimeter Calibration Form.
- 3.2.3 Calculate the exposure rate of the calibrator and record on ISP-23A.
- 3.2.4 Calculate the exposure time by the following formula:
 
$$\text{Exposure time} = \frac{3/4 \text{ dosimeter scale, mrem}}{\text{exposure rate, mrem/hr}}$$
- 3.2.5 Calculate the exposure by multiplying the exposure rate times the exposure time.
- 3.2.6 Place the dosimeter in one of the holes of the calibrator.
- 3.2.7 Expose the dosimeter to the calibration source for the calculated exposure time.
- 3.2.8 At the end of the exposure time, read and record the actual dosimeter reading on Form ISP-23A.
- 3.2.9 Calculate the accuracy of the dosimeter by the following formula:
 
$$\% \text{ accuracy} = \frac{\text{calc. exposure-dosimeter reading}}{\text{calculated exposure}} \times 100$$
- 3.2.10 Any dosimeter with an accuracy greater than  $\pm 15\%$  shall be replaced.
- 3.2.11 Record all applicable information on Form ISP-23A.
- 3.2.12 Perform a Drift Check as follows:
  - a. Zero the pocket dosimeter.

- b. Store the dosimeter in a low dose area.
- c. After at least twenty four (24) hours, read the dosimeter.
- d. Calculate the Drift by the following:  
$$\% \text{ Drift} = \frac{\text{dosimeter reading}}{\text{dosimeter scale}} \times 100$$
- e. The dosimeter passes the Drift Check if the % Drift is less than 2%.

3.2.13 Apply a dated calibration label to the dosimeter which indicates the next calibration due date.

# DOSIMETER CALIBRATION FORM

ISP-23A

Calibration Source: \_\_\_\_\_ Exposure Rate: \_\_\_\_\_

| Serial Number | Calc. Reading | Act. Reading | %Acc. | %Drift |
|---------------|---------------|--------------|-------|--------|
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Performed by: \_\_\_\_\_ Date: \_\_\_\_\_

Reviewed by RSO: \_\_\_\_\_ Date: \_\_\_\_\_

#### 4.3.1 General Operating Procedures (Continued)

- d. The pipetting of solutions by mouth is forbidden. Proper precautions should be taken during glass-blowing involving radioactive materials against the inhalation of fumes that might be generated.
- e. General air ventilation shall be maintained.
- f. Local exhaust ventilation is mandatory.
- g. All effluents from local exhaust systems and from controlled areas must be properly filtered before being discharged to the outside. The "Cambridge" Absolute Filter or the "Mine Safety Appliance" Ultra-Air Filters have been found satisfactory.
- h. Know the properties of the material with which you are to work and attempt to identify and determine its activity.
- i. Plan ahead each step of the operation prior to entry into the controlled area. This should include action to be taken in the event of emergencies.
- j. Frequent house - cleaning and good personal hygiene practices are essential.
- k. Isotope shop surfaces are designed to prevent the accumulation of dust and must be kept clean.
- l. Consult frequently with the Radiation Safety Officer.

#### 4.3.2 Specific Operating Procedures

- a. Cell and Decontamination Room - Respirators and rubber gloves must be worn in this area.

#### 4.3.3 Accidents and Emergency Techniques

Refer to the AMS Radiological Contingency Plan.

#### 4.4 Protective Clothing

The company furnishes a complete change of clothing which must be worn by any person performing work in any controlled area where radioactive contamination is known to exist or is suspected.

#### 4.2.2 Specific Procedures:

- a. Source Transfer Operations - In any operation involving movement of a source from one container to another, there is a "flash" of higher radiation intensity as a source crosses the fine gap between the containers. For this reason, the area around any transfer operation must be cleared of all personnel not required for the transfer and the operating personnel must observe appropriate procedures. Transfer operation procedures are presented in the source exchange manuals.
- b. Entering the Cell - See ISP-11 in Appendix A.
- c. Entering the Equipment Room - This room is located directly above the Shielded Work Room and has adequate floor shielding for our operations. A Gammalarm in the Equipment Room gives a red signal if the radiation level exceeds 2 mR/hr and remotely indicates the signal above the entrance to the room. WHEN THERE IS NO SIGNAL LIGHT OR THERE IS A RED LIGHT, PERSONNEL ARE NOT PERMITTED IN THIS ROOM UNTIL CLEARED BY THE RADIATION SAFETY OFFICER.

#### 4.3 Internal Hazards

Deposition of radioactive materials in the body may constitute one of the more serious hazards likely to be encountered. This may result from ingestion, inhalation and absorption or entry through the skin. It must be remembered that, apart from the accidental swallowing of a radioactive solid or solution, ingestion may take place quite unnoticed over long periods of time through contaminated food, cigarettes or other articles brought to the mouth. The presence of radioactive dust or spray in a laboratory may lead to similar chronic intake through inhalation. The following procedures are designed to prevent this internal hazard:

##### 4.3.1 General Operating Procedures

- a. Do not eat, drink or smoke in any controlled area or when handling any radioactive source.
- b. Personnel with open cuts or lesions on hands shall refrain from working in potentially contaminated areas.
- c. Never handle radioactive isotopes with bare hands. Forceps, rubber gloves or some other interposing device should always be used.

## CHAPTER 4 - PROCEDURES FOR HANDLING RADIOISOTOPES

### 4.1 Hazardous Qualities of Isotopes

All use of isotopes is to be considered hazardous and requires approval by the Radiation Safety Officer. Special care must be exercised in handling isotopes.

The use of Cobalt 60 and Cesium 137 requires careful planning of operations since both are penetrating gamma radiation emitters.

The Cesium 137 used will always be in the form of sealed sources.

Depleted uranium is used as shielding material in source head construction. This material is purchased in the final form. This material is nickel plated. No machining is done after receipt; therefore, a low hazard is presented.

The Cobalt 60 will be in the form of solid metal. This metal, even though plated, can oxidize and, therefore, a greater possibility of airborne contamination exists. Once this solid metal is encapsulated into sealed sources, this problem is almost eliminated.

The sealed sources are used or handled with loading equipment only in the controlled Isotope Shop Area or the Shielded Work Room.

### 4.2 External Hazards

#### 4.2.1 General Operating Procedures

When working with sources of penetrating radiation, the following steps will help maintain levels of exposure ALARA: See ISP-14.

- a. Plan each step of the operation thoroughly in advance to keep exposure at a minimum.
- b. Keep as far away from the source as practical at all times.
- c. Avoid getting radioactive isotopes on the hands. Hands should be kept at a safe distance from the source, as even small sources will cause burns if the distance is close enough.
- d. Interpose a proper shield between you and the sources whenever practical.
- e. Obtain actual exposure data with the proper monitoring instruments.
- f. Know the properties of the material you are going to work with.
- g. Attempt to positively identify the radioactive material and determine the activity.
- h. Consult frequently with the Radiation Safety Officer.